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**FINANCIAL INTEGRATION OF SIX FORMER YUGOSLAVIAN  
EQUITY MARKETS: EVIDENCE FROM THE FINANCIAL CRISIS**

Master's Thesis in  
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**ABSTRACT**

This thesis investigates the financial integration of former Yugoslavian countries' equity markets into developed markets with respect to the financial crisis of late 2000s. The purpose of the study is to investigate whether the former Yugoslavian countries became integrated globally before the financial crisis and if the integration process increased or decreased during the crisis.

The sample includes six former Yugoslavian equity markets, specifically Serbia, Slovenia, Croatia, Bosnia & Herzegovina, Montenegro and FYR Macedonia as well as the US and German equity markets. Financial integration and dynamic linkages are tested with vector autoregressive framework, specifically cointegration vectors as the unit root tests, Johansen procedure, Granger causality test and exclusion test are employed.

The empirical findings indicate that Croatia and Slovenia represent markets with considerable financial integration towards developed markets of US and Germany. Serbia, Bosnia, Montenegro and Macedonia only showed the short-run cointegration with mature markets during the financial crisis period. The financial integration among the former Yugoslavian countries increased during the financial crisis. Croatia represents a dominant market in the region of former Yugoslavia affecting the returns of every other market in the region significantly. The role of Serbian market in the region increased during the financial crisis period. Due to the level of financial integration, superior portfolio returns for international investors are rather limited in case of Croatia and Slovenia as these markets' returns are in the long-run equilibrium with mature markets. However, diversification benefits can be pursued by investing in other former Yugoslavian countries.

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**KEYWORDS:** Former Yugoslavia, financial integration, financial crisis



## 1. INTRODUCTION

According to the International Finance Corporation, a market located in a low- or middle-income economic region with the capitalization rate too low compared to the recent GDP figures is considered to be an emerging market. Special type of emerging markets, called the frontier markets provide great investing opportunity due to high returns especially in the pre financial crisis period. Frontier markets are relatively small and less liquid compared to emerging markets but still have their own equity exchanges. All of the former Yugoslavian markets, according to these definitions could be classified as frontier markets. The FTSE list of the frontier markets includes Croatia, FYR Macedonia, Serbia and Slovenia. Another frontier markets index developed by MSCI includes Croatia, Serbia and Slovenia while Bosnia and Herzegovina is under consideration as of May 2010. Finally, the Standard and Poor frontier market list includes only Croatia and Slovenia from former Yugoslavian countries.

The research of frontier market integration with developed markets increased in past decade. During the past decade the frontier markets all over the world offered excessive returns to the international investors with diversified portfolios. However, the economic and political instability kept investors away from the former Yugoslavian countries in years following the civil war 1991-1995. The stock markets of the former Yugoslavian countries have been ignored as well due to the lack of the common acceptable accounting standards and the corporate transparency. Today however, the situation is changing for the better. Former Yugoslavian countries have opened their markets to the industrial world in order to increase the capital and trade flows (Rec 2009). All of the former Yugoslavian countries except Slovenia - already a member of EU since 2004, are in the transition of joining the European Union. Since early 2004 Croatia is a candidate of joining the EU and the official accession is scheduled for 2013. Serbia, Montenegro and Macedonia are candidate countries of EU. In recent years former Yugoslavian countries have promoted the major reform policies that include macroeconomic stabilization, market liberalization, restructuring and privatization of state-owned corporations (IMF 2005) in order to make their way into the European Union. The growth of Foreign Direct Investment and other forms of capital flows from the developed countries accelerated the financial integration of former Yugoslavian stock markets (Rec 2009).

Former Yugoslavian countries' economies experienced the rapid growth in years preceding the financial crisis in terms of per capita, international competitiveness, and foreign direct investment (FDI) allocation (Kekic 2005). Therefore, the process of integration with major global and European markets has already started. Late 2000s financial crisis started in 2007, and erupted in 2008 affecting the whole world's economy and therefore the former Yugoslavian markets as well. According to International Monetary Fund (IMF), this financial crisis is the largest financial shock and the worst crisis happened since the Great Depression of 1930s. The crisis resulted in downturn of stock markets all over the world. The impact of this financial crisis on the stock markets worldwide is vast: high correlation and transmission of price relevant information, increased co-movements among stock markets during the crisis etc. (Longin & Solnik 2001; Bartram & Bodman 2009). It is interesting to see if this global crisis interrupted or accelerated the integration of the small equity markets of these young European countries. These relationships could be interesting to the foreign investors since, depending on the level of integration, former Yugoslavian equity markets can offer the profitable opportunities for their diversified portfolios as risk hedging possibilities (Syriopoulos 2011).

### **1.1. Previous studies**

There is a limited amount of empirical studies about European frontier equity markets integration. That is especially the case with six former Yugoslavian equity markets. So far it has been concluded that these equity markets could be very interesting for foreign investors especially for the short-run opportunities for international asset allocation (Syriopoulos 2011). Syriopoulos (2011) uses the error-correction vector autoregressive framework and cointegration vectors to model and test for the financial integration. Based on active portfolio management strategies, former Yugoslavian markets nowadays could be very tempting for international investors and their short-run mispricing opportunities. Additionally the pattern of the long-run integration is spotted, where all of the Balkan markets, including Croatia, will become more and more integrated with global mature markets (Syriopoulos 2011).

Slovenia and Croatia showed a considerable amount of integration with world markets and three largest European markets (Nikkinen et al. 2011). This study investigates the level of integration of European emerging frontier markets before and during the 2008/2009 financial crisis. Additionally a significant interdependence between Croatia

and Slovenia is found. Specifically, the impact of the world market returns on Croatian stock market returns was increased from 4% before the crisis to 42% during the crisis (Nikkinen et al. 2011).

Syriopoulos (2004) examines the financial integration of central European markets with USA and Germany. An error vector correction model is used for testing the presence and the number of cointegrating vectors between the markets. One cointegrating vector was found indicating the long-term equilibrium among the returns of central European markets with US and Germany. The diversification benefits for investing in central European markets are rather limited due to the long-run co-movements between these and developed markets (Syriopoulos 2004).

Yang et al. (2003) studies the short- and long- run relationships between the markets of ten Asian emerging countries and the US and Japanese developed markets during the Asian financial crisis. Financial integration is tested for four periods: pre-crisis, crisis, transition and post-crisis. Therefore, the effect of the financial crisis on integration has been examined. Both long-run cointegration and short-run casual linkages are found to be straightened between the markets included in study during the financial crisis period (Yang et al. 2003).

In his studies of the comovements of equity markets of countries located on Balkan Peninsula (South-east Europe) and developed global stock markets, Samitas (2006) concluded that it is possible to predict the short-run returns of Balkan stock markets and due to their cointegration level with developed markets make the exceptional returns. Furthermore, it is predicted that the Balkan stock markets overact to any shocks and information from the developed stock markets such as US or Germany. Additionally, the interdependencies between Balkan and global stock markets are proven to exist, specifically in case of Serbia, Croatia and FYR Macedonia (Samitas 2006). Additionally, interrelationships and comovements linkages between Balkan and other European emerging stock markets with mature markets are found in Syriopoulos (2006).

Considerable degree of financial integration towards developed markets is found in case of Croatia and Slovenia (Piljak 2008). Piljak (2008) uses the variance decomposition models to test the levels of financial integration and interdependencies across the frontier markets. High level of integration towards the largest European stock markets UK, France, and Germany are found in case of following European frontier markets: Croatia, Estonia and Slovenia. The biggest influence on returns to the selected frontier

markets comes from France. Additionally, this study reveals a significant interdependence between Slovenia and Croatia. Piljak (2008) also points out the potential benefits from international diversification portfolio through investing in European frontier markets, namely Slovenia and Croatia.

Multilateral integration of Croatian stock market with Central-European equity markets, especially with Slovenia and Germany is found in Vizek & Dadic (2006). This research points out the strong forces driving this financial integration as Vizek & Dadic (2006) suggest that even more significant integration between these markets is yet to come as Croatia becomes a member of European Union. The integration towards Central-European countries is facilitated with liberalization of capital flow barriers between the countries, potential high returns offered by the transition economies as well as increasing trade linkages between the old EU countries and new candidate countries (Vizek & Dadic 2006).

Financial market integration of four former Yugoslavian countries was explored by Rec (2009). Rec (2009) investigates the integration stock markets of Bosnia & Herzegovina, Croatia, Serbia and Slovenia with the major international markets (Austria, US, UK and Japan) in order to explore the potential diversification benefits using the methodology of Johansen procedure correlation analysis and Granger casualty tests. A presence of cointegration between markets of Bosnia and Serbia, Serbia and Slovenia and Bosnia and Slovenia is found. Furthermore, the bilateral cointegrating relationship is found between Serbia, Croatia and Slovenia with stock markets of developed countries (Rec 2009).

Mateus (2004) investigates the predictability of returns and global risk factors of 13 European accession markets. Slovenia was included in the sample and the findings propose that returns could be predicted based on market inefficiency and local information. This research further concludes that the integration of Slovenian stock market with developed world is on the low level. Another research made by Maneschiöld (2006) examines Baltic frontier markets integration with US, Japanese, German, UK, and French markets. Low degree of integration between Baltic countries and mature stock markets are found which gives the international investors the diversification benefits with long-term investment horizon.

Tomfort (2006) investigates the financial integration of East European countries with matured European and world equity markets. The main finding of this paper is that the

dynamic financial integration process has already happen. However, Tomfort (2006) also states that there is still lot of room for more integration to come in the future. Additionally, the Central East-European countries showed higher level of financial integration compared to the South East-European countries (Tomfort 2006). The research also concludes that due to the attractive return opportunities of Eastern-European markets, possibility of European Union succession, economic integration, legal liberalization and harmonization efforts to comply with global standards, the international investors will broaden their investment base towards these markets in the future.

Voronkova (2004) investigates the financial integration of emerging Central-European stock markets with mature world and European markets. The key finding of this paper is that the significant long-run relationships are found with emerging Central-European equity markets and mature markets. The research suggests that the international investors need to be aware of increasing financial integration between Central European markets with the world for their risk management strategies (Voronkova 2004).

Many research papers focus on integration of major European stock markets (Yang 2003; Bessler & Yang 2003; Phylaktis & Ravazzolo 2002; Dickinson 2000; Ejara 2001). There is a considerable amount of researches concerning the relationships between the mature West European markets, emerging Asian and Latin American markets with US stock market (Tomfort 2006). Specifically the long-run comovements were investigated between these markets to evaluate the diversification possibilities based on the portfolio theory (Johansen 1998, Engle & Granger 1997). The financial integration between developed West-European markets with US equity market is found in early studies (Francis & Leachman 1998, Kasa 1992). Additionally, the integration is investigated and its existence is proven in case of Latin American and Asian emerging markets towards the US market in Manning (2002), Phylaktis (1999), and Chen et al. (2002). .

Large body of research papers studied the financial integration of stock markets across regions (Swanson 2003; Chen et al. 2002; Chaudhuri & Wu 2003). Swanson (2003) supports many previous researches about the financial integration and finds strong evidence that the international equity markets are becoming increasingly integrated over time. Chen et al. (2002) investigates the financial integration and linkages between the six major stock markets in Latin America. Creation of trade alliances between the countries as well as the deregulation and privatization plans made by the Latin

American countries caused the higher financial integration (Chen et al. 2002). The results further indicate that Latin American countries offer limited risk diversification possibilities to the investors.

## **1.2. Purpose of the Study and Hypothesis**

Financial market integration and liberalization is a topic that is getting more and more importance, especially in last two decades with the progress of globalization. However, the financial markets of former Yugoslavian countries have not been the topic of many research papers due to the political and economic instability in that geographical region in the past. Nowadays as the turbulence period is over, all of the former Yugoslavian countries opened their markets for international investors. As the financial crisis of late 2000s is still affecting the world's economy and that Euro Debt Crisis is challenging the entire European Union, this could be a right moment for the investors to diversify their international portfolios by investing in some of the former Yugoslavian countries.

The purpose of this study is to add to a limited body of research about the financial markets of former Yugoslavian countries. It is interesting to see where the each country stands now in terms of financial integration with the two biggest markets of North America and Europe. The aim of the thesis is to also expand the empirical research about the linkages and co-movements between the frontier and mature global equity markets. It explores the major economic event in recent history (Late 2000s financial crisis) effects on the integration process of each individual country towards the developed markets. Finally, this thesis has the ambition to familiarize readers with the economic situation of former Yugoslavia region as well as the local equity exchanges' characteristics as the eventual possibilities for international diversification benefits for the foreign investors are explored.

I hypothesize that Slovenia and Croatia are integrated more with developed markets compared to other former Yugoslavian countries. This should be the case due to the fact that Slovenia is a member country of EU since 2004 as Croatia enjoys the status of candidate and will become a full member in 2013. Additionally, it was proven that Slovenia and Croatia showed high level of interdependence. Secondly, I hypothesize that the Late 2000s financial crisis resulted in higher integration of all former Yugoslavian countries with developed markets. It has been proven that the financial



crisis can bring the equity markets more closely together and therefore I predict that Late 2000s financial crisis will lead to higher market integration of each of the six former Yugoslavian countries with two largest stock markets of North America and Europe.

Following stock market indices are used in this study to represent each former Yugoslavian stock market exchange: BELEX line (Serbia – Belgrade Stock Exchange), SBI TOP (Slovenia – Ljubljana Stock Exchange), CROBEX (Croatia – Zagreb Stock Exchange), SASX-10 (Bosnia & Herzegovina – Sarajevo Stock Exchange), MONEX-20 (Montenegro – Podgorica Stock Exchange), and MBI 10 (FYR Macedonia – Skopje Stock Exchange). The New York Stock Exchange S&P500 index is my North American representative while DAX (German stock index) is a European representative. Each of the former Yugoslavian stock market is examined and analyzed separately.

The methodology used in this study is similar to the one used in Syriopoulos (2004, 2011). Unit root tests are employed to examine the stationarity in the data. Unit root tests include Augmented Dickey-Fuller (ADF) test and the Phillips and Perron (PP). The co-integrating vectors are used to test for the dynamic linkages and interdependencies between each former Yugoslavian country with US and Germany. The presence and the number of cointegrating vectors between stock markets are tested for two periods: first period extends from March 2006 to September 2008 which represents the pre-crisis period as the crisis period is tested during September 2008 – March 2012. September 15, 2008 is the date of investment bank Lehman Brothers bankruptcy and is selected as major event related to the Late 2000s financial crisis. Johansen procedure vector-error correction model (VECM) is used since it allows testing for the number of cointegrating vectors and therefore the relationship between the stock markets. Direction and impact of the relationship between former Yugoslavian and developed stock markets is tested with the Granger causality tests and F-test statistics. Finally, the exclusion test is employed for determining whether certain stock markets are excluded from the long-run financial integration relationships.

### **1.3. Construction of the Study**

The study is divided into six chapters. Chapter 1 represents the introduction to the subject with the review of previous literature as well as the purpose and hypothesis of the thesis. Chapter 2 is consisted of the theoretical background where the Modern

portfolio theory based on Capital Asset Pricing Model is explained. Furthermore the diversification strategy is explained with emphasis on international diversification. Finally, the essentials of financial market integration are explained as a conclusion of the chapter. Chapter 3 is divided into six parts where each part represents the economy of each former Yugoslavian country. Chapter 4 represents the methodology of the research with description of the data and statistics included as well. The empirical results will be presented in Chapter 5 as the conclusion will be drawn at the end of that chapter as well. Chapter 6 summarizes the results of the study and points out to further research.

## **2. THEORETICAL BACKGROUND**

The purpose of this chapter is to give the most important theoretical background to the reader as the foundation and better understanding of the study. Markowitz's Modern Portfolio Theory is explained first, following with the Capital Asset Pricing Model (CAPM) assumptions and main ideas. Second part of the chapter describes the diversification strategy with the special emphasis on international diversification.

### **2.1. Portfolio Theory**

Among the most important decisions that investors face is how to allocate their wealth among different alternative assets. Financial institutions on the other hand, besides allocation problem have to also consider the characteristics of their liabilities in the analysis. These problems faced by investors and financial institutions, even structurally different can be classified as the portfolio theory problems (Elton et al. 1997). Portfolio is basically the collection of investment assets such as stocks, bonds, commodities, real estate, and others (Bodie et al. 2009: 9). The modern portfolio theory was developed by Harry Markowitz. Since then many researches have been reviewing and discussing the portfolio theory from different perspectives (Constantinides & Malliaris 1995; Ingersol 1987; Huang & Litzenberger 1988; Szegö 1980; Elton & Gruber 1997).

Markowitz formulated the theory of optimal portfolio led by the trade-offs between risk and return with the focus on the idea that the portfolio diversification can lead to reduced risk. He saw the portfolio problem as the decision between the mean and variance of different assets in portfolio. Markowitz has proved that holding the variance to remain constant the expected return will be maximized. Additionally, holding the expected return to be constant will minimize the variance (Elton et al. 1997). Therefore, the efficient frontier is formed where the investors can choose their preferred portfolio depending on the level of risk they are willing to take. However, Markowitz states that it is very crucial that investors need to consider the relationship that each security in the portfolio has with other securities. Thus the co-movements of the securities have taken into the account give us the better, improved portfolio with the same return but lesser risk than the one that ignores the relations between the securities.

In years following the Markowitz's modern portfolio theory discovery some researches started to question that such complicated phenomena as portfolio could be explained

only by the mean return and variance and that some additional variables should be included into the equation as well. Fama (1965) introduced skewness as additional variable in calculating the ideal portfolio. Other researchers considered this approach to represent the distributions of return more accurately than the original theory (Elton & Gruber 1974; Lee 1977; Kraus & Litzenberger, 1976). However, despite all other explanations, Markowitz's mean variance theory approach is still a foundation to risk and return relationship and the modern portfolio theory. According to Elton et al. (1997) there are two reasons why that is the case. First, it has been proven that adding the additional moments to already existing large amount of data requirement of the mean variance theory does not improve the desirability of the portfolio selected. Second reason is simply that the implications of the theory developed by Markowitz are well established and have great intuitive appeal. For example, it is not necessary for someone to completely understand the mean variance theory in order to work with risk measure – beta which is the term developed from the mean variance theory (Elton & Gruber 1997).

Markowitz's mean variance portfolio theory can help investors to find the optimum portfolio for the single period. One of the major challenges left behind Markowitz's theory is how to convert it to fit if the investor's real problem is multi-period in nature (Elton et al. 1997). Various assumptions were taken into account and the problem is solved as to look at the multiple-period as sequence of single-periods. The new preferred portfolio is now different from the one that was optimum for the single-period since the utility function has changed (Fama 1970; Hakansson 1974; Merton 1990).

An additional branch of research about the Markowitz variance portfolio theory is separation theorem. Separation theorem states that in case when the investor has an access to the risk free asset, it is very easy to prove that investor's choice of optimum portfolio of the risky asset will be independent of investor's taste for variance or the expected return (Elton et al 1997). Therefore, the optimal portfolio represents the tangency to the line passing through the risk free asset in the expected return standard deviation space. This theorem further implies that the desired portfolio should be consisted of two mutual funds: first one made of risk free assets, and second one that represents the tangency portfolio. This approach is also known as the mutual fund theorem. Furthermore, the mutual fund industry is interested in calculating the number and nature of mutual funds that can be included in order to construct the preferred portfolio. Some researches such as Ross (1978) set standards and guidance in mutual funds industry, banks and insurance companies, all based on the Markowitz's thinking. Other types of research about the portfolio theory have focused on portfolio problem in

continuous time and how current holdings as well as the transaction costs could affect the portfolio rebalancing (Elton & Gruber 1997).

With the development of Markowitz mean variance portfolio theory, for the first time in the financial literature the covariance estimation was required. Therefore, the index models were introduced for that purpose. Single-index model was the first one to be discussed by Markowitz, and fully developed by Sharpe (1967). Single-index model is represented in the following equation (Elton & Gruber 1997):

$$(1) \quad R_{it} = \alpha_i + \beta_i R_{mt} + e_{it},$$

where:  $R_{it}$  = the return of stock I in period t,

$\alpha_i$  = unique expected return of the security,

$\beta_i$  = the sensitivity of stock I to market movements,

$R_{mt}$  = the return on the market in period t,

and  $e_{it}$  = unique risky return of security I in period t and has a mean of zero and variance  $\delta_{ei}^2$ .

This single-index model was widely used since it reduced the number of estimates required. Additionally, the type of inputs required was easy to understand and analyze. Therefore, the single-index model provided the accuracy in portfolio optimization and improvement forecasting, despite the fact that it uses the subjective estimations and subjective modification of historical data in its calculations. A good example of this is mentioned in Elton et al. (1997): a steel engineer analysis is able to understand the connection between the steel and market in much better and easier way calculate covariances and betas in that connection than for example between steel and General Foods (Elton & Gruber 1997). Therefore, the single-index model was extensively used well beyond simply estimating the inputs such as estimations of risk levels - beta.

Another model was developed as an improvement to single-index, called the multi-index model. This model explains the reality in better way than the single-index. The multi-index, widely used for portfolio optimization techniques, can be represented with following equation:

$$(2) \quad R_{it} = \alpha_i + \sum_{j=1}^J \beta_{ij} I_{jt} + e_{it}, \quad i = 1, \dots, N,$$

where:  $\beta_{ij}$  = sensitivity of security I to index j

$I_{jt}$  = the  $j$ th index

$J$  = total number of indexes employed

$R_{it}$  = the return of stock  $I$  in period  $t$ ,

$\alpha_i$  = unique expected return of the security,

$\beta_i$  = the sensitivity of stock  $I$  to market movements,

$R_{mt}$  = the return on the market in period  $t$ ,

and  $e_{it}$  = unique risky return of security  $I$  in period  $t$  and has a mean of zero and variance  $\sigma_{ei}^2$ .

Multi-index model however, had an issue with how many indexes should be used and what type (Elton 1997). It was concluded that using pre-specified indexes gives the most accurate results. Pre-specified indexes can be divided into three groups. First are market-plus-industry indexes. Second are surprises in basic economic indexes, while the third group include portfolio of traded securities (indexes of small minus large securities). Like the single-index model. The multi-index model is used in other areas besides the portfolio development. The arbitrage pricing theory has its roots in multi-index theory. In addition, the influence of portfolio to various external economic influences is calculated with multi-index theory. Multi-index theory is a cornerstone for calculating the changes in indexes for future periods. Some managers use the multi-index theory in order to reformulate the mean variance theory and bring it more closely to their fields of expertise. However, the most important implementation of multi-index theory is the simplification of inputs for the portfolio selection as well as understanding and visualizing the preferred portfolio development.

It is also important to mention the next step of the portfolio theory after the portfolio selection: portfolio evaluation. It has been proven that correct portfolio management techniques used for the evaluation measures can add value to our portfolio. Early portfolio evaluation researchers rather ignored any consideration of the risk in their calculations and theories, evaluating only for the performance (Cowles 1933). However, newer research papers guided with modern portfolio theory included risk and return in evaluating the performance. The most important three models of portfolio evaluation that are used today are developed not that long after the Markowitz's development of modern portfolio theory: Treynor ratio (Treynor 1965), Sharpe ratio (Sharpe 1966), and the Alpha Jensen ratio (1969). All three models are based on Capital Asset Pricing Model (CAPM) theory (Joro et al. 2009). The basic difference between three mentioned ratios is that Sharpe uses the total risk in its ratio calculation, while Traynor and Jensen use betas as the measure of risk. All three researches evaluated the performance of the

portfolio based on the fact that risk free asset - portfolio combination can be represented by a straight line in expected return beta (or standard deviation) space (Elton and Gruber, 1997). All three models are almost equally used since on average the 90% correlation exists with results calculated by all three models. However, Jansen's alpha model has a little more attention over the others due to the fact that it tests for the statistical significance while the other two do not. Another advantage of Jansen's alpha model is that it uses the actual returns and not average returns as other two do, during the observation periods. Jensen's alpha represents the intercept with the time series regression that follows:

$$(3) \quad R_{Pt} - R_{Ft} = \alpha_p + \beta_p(R_{mt} - R_{Ft}) + e_{Pt},$$

where:  $R_{Pt}$  = return on the portfolio being evaluated at time t,  
 $R_{Ft}$  = risk free rate in period t,  
 $R_{mt}$  = return on the reference portfolio,  
 $\beta_p$  = the sensitivity to the reference portfolio,  
and  $e_{Pt}$  = mean zero random error

Jensen's alpha model requires that we use different risk free rate for the every observed time interval. Additionally, every risk free rate needs to be subtracted from the return in each period that we observe. The risk premium is calculated in terms of betas – systematic risk. Therefore, the diversification ability of the portfolio managers is not evaluated by the Jensen's alpha theory (College of Business and Economics 2012). Another issue with this theory is finding the correct index (Roll 1978). However, with the use of right index Jansen's alpha theory is adequate to use, especially in case of mutual funds as well as other diversified portfolios.

## 2.2 Capital Asset Pricing Model (CAPM)

Twelve years after Markowitz developed the modern portfolio theory, Sharpe, Lintner, and Mossin established the capital asset pricing model – CAPM (1964-1966). In its simplest version, CAPM uses the following assumptions (Bodie et al. 2009):

1. First assumption states that there are many investors and all of them are price takers. Therefore, the security prices are unaffected by the individual investor trades.

2. All of the investors in the market make plans only for one identical holding period. This assumption is short-sighted and unrealistic in the markets today.
3. Investors are limited to only publicly traded financial assets (stocks and bonds for example) and investments in non-traded assets do not exist (education or private enterprises for example). Furthermore, investors borrow and lend the money only on fixed risk free rate.
4. Taxes and transaction costs on trades in securities paid by investors are ignored. Of course, this is not the case in reality, since taxes play big role for the investors in choosing the appropriate type of securities to invest in. In addition to that, fees and commissions could also alter the investors' decisions.
5. All investors use Markowitz modern portfolio model to govern their decisions and all of the decisions they make are fully rational mean-variance optimizers.
6. Analyzing the securities is done the exact same way by all of the investors. The result of this assumption is the identical estimates of the future cash flows distribution from investing in the selected securities. Additionally, investors use identical expected returns and covariance matrix of selected security returns in order to develop the preferred portfolio – also known as homogeneous expectations.

These assumptions obviously ignore many real-world complexities (Bodie et al. 2009). However, despite the issues it has the CAPM can help us to understand much better the nature of balance in security markets. Bodie et al. explains and simplifies the CAPM philosophy in four basic points:

- All investors in the market will hold the identical risky portfolio, since the individuals always try to optimize their personal portfolios. These identical portfolios represent the imitation of the assets in the market portfolio (the portfolio that equals the entire wealth of the economy). The proportion of the risky assets in the preferred portfolio (for example stocks) is the market value of that stock divided by total market value of all stocks.
- The market portfolio as the portfolio with the highest possible expected return for any volatility will be the one that represents the tangency portfolio to the capital allocation line (CAL). Capital market line (CML) is the line that starts from the risk free rate and goes through the market portfolio. Therefore, all investors will hold this market portfolio as their optimal risky portfolio while the only distinction between their portfolios will be that some will invest more in risk free asset while other will decide



to invest more in portfolio. Thus the market portfolio can be called as the mean-variance efficient tangency portfolio. According to CAPM theory the passive strategy is efficient. Passive management means that investors hold highly diversified portfolio without doing any security analysis and spending any resources trying to improve the portfolio performance. CAPM assumes that markets are efficient and therefore “only fools would commit resources to actively analyze securities” since the prices reflect all the relevant information (Bodie et al. 2009: 11). Since CML represents the highest possible expected return for any volatility, it is important to calculate its slope. The slope of CML is called the Sharpe ratio. Sharpe ratio is the reward to volatility ratio for the portfolio combined with risk free investment. It is calculated by subtracting the risk free rate from the portfolio’s rate of return and dividing the result with the standard deviation of portfolio’s return. Sharpe ratio is important because it is basically telling us are the returns from our portfolio due to our smart investment or just the result of excess risk taking.

- When it comes to risk premium on the market portfolio the CAPM theory states that it is closely related to portfolio’s risk as well as the risk aversion of the particular investor:

$$(4) \quad E(r_M) - r_f = \bar{A}\sigma_M^2 \times .01$$

where:  $\sigma_M^2$  = variance of the market portfolio

$\bar{A}$  = average degree of risk aversion across investors

and:  $M$  = optimal market portfolio, diversified across all stocks

- CAPM theory states that individual assets’ risk premium are relative to the risk premium of the whole market portfolio. Additionally, beta coefficient of one individual asset is proportional to the market portfolio as well. Beta ( $\beta$ ) is the measure of volatility or the security’s sensitivity to changes in market portfolio. It measures the securities’ marginal influence on whole market portfolio risk (Brealey & Myers 1996). Beta with value of 1.0 represents the security that will move together with a market. If securities have beta greater than 1.0 they are called “aggressive” since their returns respond more than one-for-one to changes in the market. On the other side, securities with betas value of less than 1.0 are less volatile than the market itself. Equation (5) represents the CAPM definition of beta and the

equation (6) is the formula for calculating the risk premium on the individual assets in the portfolio. Following these equations is the market portfolio M represented as a tangency point of capital market line and efficient frontier:

$$(5) \quad \beta_i = \frac{\text{Cov}(r_i, r_M)}{\sigma_M^2}$$

where:  $\sigma_M^2$  = variance of market portfolio

and  $\text{Cov}(r_i, r_M)$  = covariance between returns on stock  $i$  and market portfolio

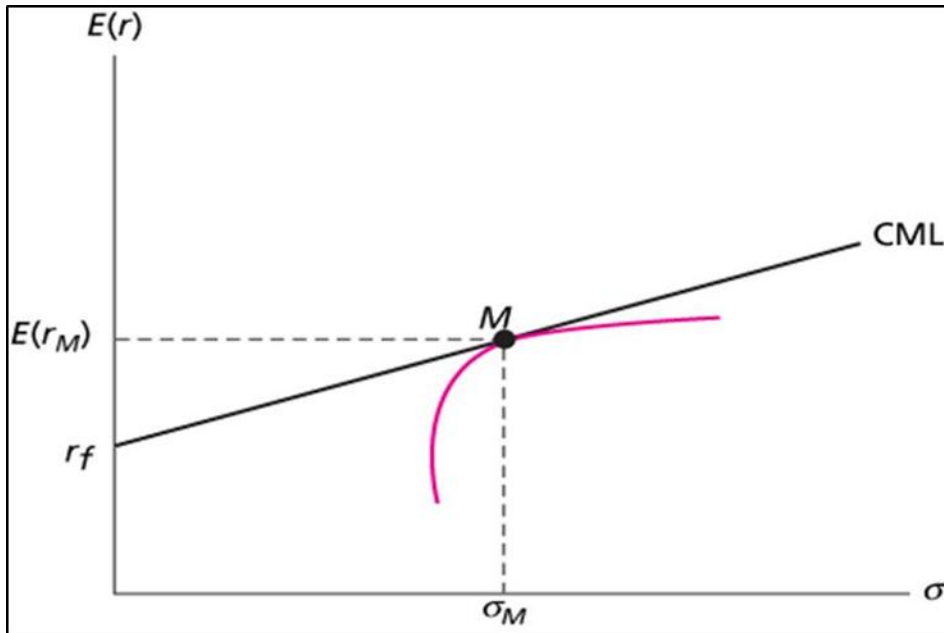
$$(6) \quad E(r_i) - r_f = \beta_i [E(r_M) - r_f]$$

where:  $E(r_i)$  = expected rate of return on a security

$r_f$  = risk-free interest rate

$\beta_i$  = Beta

$E(r_M)$  = return rate on appropriate asset class



**Figure 1:** The efficient frontier and the capital market line (Source: Bodie et al. 2009)

### 2.3. Diversification strategy

Diversification by definition, means that large amount of assets are included in portfolio and therefore the exposure to any particular asset is limited (Bodie et al. 2009: 11). The main benefit from diversification is the reduction of risk. In case we hold the portfolio of only one stock in it, that portfolio is exposed to two types of risk. First is the risk from general economy (for example business cycle movements, inflation, interest rates etc.), while the other is the risk specific to that particular company or the industry the company is in. However, if we include other stocks to our portfolio from different companies and different industries our risk is considerably reduced. Due to the fact that now the firm-specific risk is spread out to many stocks its influence to our whole portfolio is significantly lowered. Therefore, if we keep adding more and more different stocks to our portfolio, eventually, our firm-specific risk (also called unique risk, nonsystematic risk, or diversifiable risk) influence on our portfolio will completely diminish. Our portfolio will be affected with only by the macroeconomic risk of the whole economy (also called market risk, systematic risk or nondiversifiable risk). Therefore, the risk reduction is the basic idea behind the portfolio diversification strategy.

Diversification strategy states that the risk of our portfolio does not depend only on the number and types of assets included in. The links and relationship between the securities in our portfolio is very important in calculating the risk as well. Therefore, the concepts of correlation and covariance are very important part of the diversification strategy. Covariance is by definition the measure of movement degree between two risky securities. The concept of covariance is extremely important because it represents suitable measure of a single asset contribution to the total portfolio risk (Copeland & Weston 1988: 156). The covariance between two assets X and Y in our portfolio can be calculated by the following formula (Copeland & Weston 1988: 157):

$$(7) \quad COV(X, Y) = E[(X - E(X))(Y - E(Y))] ,$$

where:  $COV(X, Y)$  = the covariance between the securities X and Y,  
 $X$  = the realized return for security X,  
 $Y$  = the realized return for security Y,  
 $E(X)$  = the expected return for security X,  
and  $E(Y)$  = the expected return for security Y.

Covariance is usually represented by the statistical interpret called correlation coefficient (Bodie et al. 2009). Correlation coefficient has value in range between -1.0 and 1.0. In case that two securities have a correlation coefficient of -1.0 they are perfectly negatively correlated, which means that their values move in opposite directions. For example, if the value of one security increases by 20% the other security value will go down by 20%. Therefore, we can be losing money due to investing in one asset, but at the same time we are winning money from the other perfectly negatively correlated asset. Thus our portfolio is partially hedged and our total risk is lowered (Copeland & Weston 1988: 157). Correlation coefficient of 0 for two securities means that no relationship exists between them and that their returns are independent, while the covariance of +1.0 represents securities with perfectly positive correlation. Perfectly positive correlation means that two securities move together in the same direction and their returns are co-dependent. Given the definition of covariance we can calculate the correlation coefficient by dividing the covariance of two assets with the product of their standard deviations:

$$(8) \quad r_{xy} = \frac{COV(X,Y)}{\sigma_x \sigma_y} ,$$

where:  $r_{xy}$  = coefficient covariance between securities X and Y,  
 $COV(X,Y)$  = the covariance between securities X and Y,  
 $\sigma_x$  = standard deviation for the security X,  
and  $\sigma_y$  = standard deviation for the security Y.

The covariance is also significant in calculating another term: portfolio variance. Portfolio variance is the fluctuation measurement for the returns of a group of securities included in portfolio. Variance is a special case of covariance. It is basically the covariance of an asset with itself (Copeland & Weston 1988: 174). To calculate the portfolio variance we need to look into standard deviations as well as the correlations between all the assets included in portfolio. Therefore the formula for portfolio variance uses the correlation coefficients and the covariance. Usually, the portfolio variance is low as the correlation coefficient between the securities included in portfolio remains low. On the other hand, the positive covariance between securities increases the overall portfolio variance. Portfolio variance for two risky assets is calculated with following formula (Bodie et al. 2009):

$$(9) \quad \sigma_p^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 COV(r_1 r_2) ,$$

where:  $\sigma_p^2$  = portfolio variance  
 $\sigma_1^2$  = first risky asset's variance  
 $\sigma_2^2$  = second risky asset's variance  
 $w_1^2$  = portfolio weight for the first asset  
 $w_2^2$  = portfolio weight for the second asset  
and  $COV(r_1r_2)$  = the covariance of the two risky assets.

As the number of risky assets increase in our portfolio, the overall portfolio variance decreases, eventually approaching the average covariance (Copeland & Weston 1988:184). For example, the portfolio of only two assets has two variance and two covariance terms. In case we add one more asset the result will be three variance and six covariance terms. One more asset added to our portfolio leads to four variances and twelve covariance terms. Theoretically, it is possible to completely eliminate the risk by adding the enough number of securities to drive the average covariance to be zero. However, that is not the case in reality, since the stocks usually move together and therefore have positive covariance (Bodie et al. 2009).

## 2.4 International Diversification

Investors gain benefits by investing in broader range of securities. This statement points out a question: *"If wider range of investment choices can benefit investors, why should we limit ourselves to purely domestic assets?"* (Bodie et al. 2009: 15). Globalization caused by increased and efficient communication technology as well as the lowered regulations lead to progress in international diversification. Cross-border trading and different types of international diversification have been in place for hundreds of years. Many researchers showed the evidence in support of international diversification as the risk reduction tool. In addition to the low risk benefit, international diversification is justified even in case where the expected returns are lower internationally than domestically. Therefore, international diversification is profitable for some countries, and possibly all despite taxes and currency restrictions as main issues involved with international diversification (Elton & Gruber 1995: 288).

For calculating the international diversification portfolio benefits Elton et al. (1995) developed the following formula (10). While the equation is from a U.S. investor's standpoint it can be used by the investors from any country considering the international

diversification. Thus, according to Elton et al. (1995) investors should hold non-U.S. securities as long as:

$$(10) \quad R_N - r_f > [R_{US} - r_f] \left[ \frac{\sigma_N \rho_{N,US}}{\sigma_{US}} \right],$$

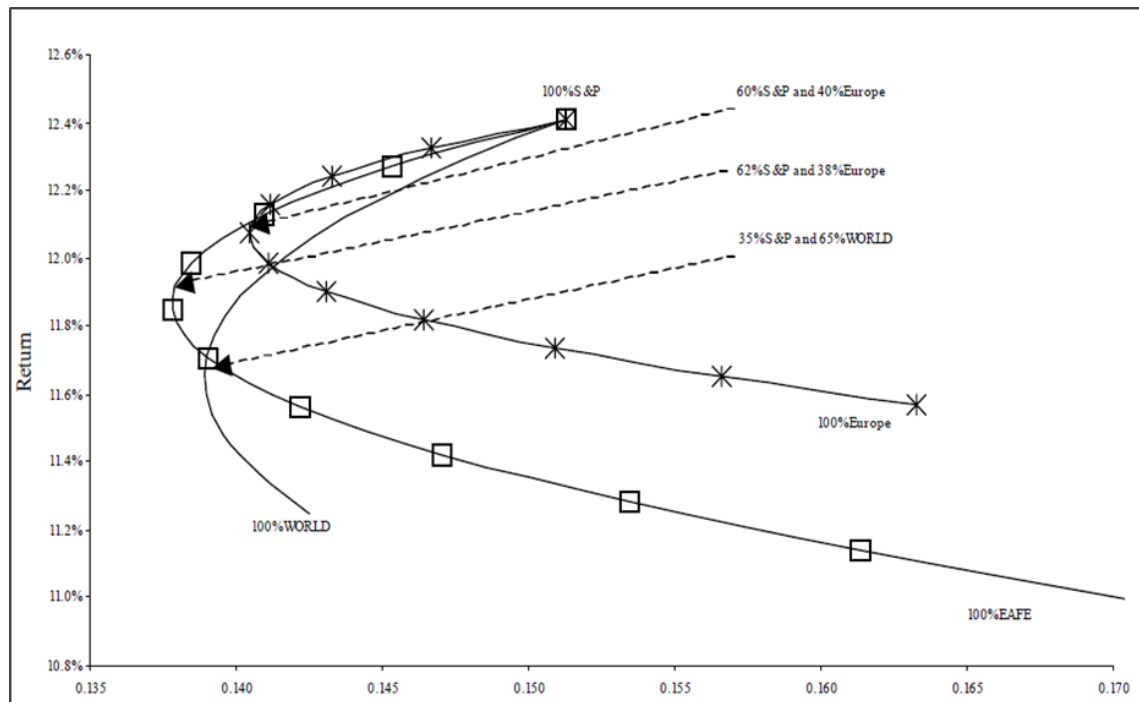
where:  $R_N$  = the expected return on the non-U.S. securities in dollars  
 $r_f$  = the risk-free rate of interest  
 $R_{US}$  = the expected return on U.S. securities  
 $\sigma_N$  = the standard deviation of non-U.S. securities in dollars  
 $\rho_{N,US}$  = the correlation between U.S. securities and non-U.S. securities  
and  $\sigma_{US}$  = the standard deviation of U.S. securities

According to Elton et al. (1995), as long as the expression in last bracket of the equation is less than one, the international diversification will be profitable, even if the expected returns are lower than those on domestic market. In his study of international diversification including seven European markets, Solnik (1974) proved that diversification internationally is to 50% less risky than holding the portfolio of U.S. securities only. Furthermore, he proved that much higher profits are gained by investing internationally. Some researchers demonstrated that diversification is beneficial for the investors especially if they diversify into emerging and less developed countries (Levy & Sarnat 1970; Lessard 1990; Errunza 1977).

However, recent studies have contradictory results when it comes to benefiting from the international diversification. Recent research papers question the profits available from the international diversification due to the globalization of financial markets (Hanna et al. 1999; Chernoff 2002). Since markets all over the world are becoming more and more integrated, potential benefits from international diversification are diminishing. Bhargava et al. (2004) concludes that the international diversification benefits are still present, but decreasing over time, due to the fact that world markets are becoming highly correlated with U.S. market. Most investors today buy mutual funds in order to diversify internationally. However, better international diversification benefits could be achieved with index funds instead. Index funds have the advantage over mutual funds due to their low expense ratios, easy access and good availability (Bhargava et al. 2004). Aiello et al. (1999) concludes that diversification gains from international index funds are significant and important. Even the international index returns did not outperform the S&P 500 index, the diversification benefits still existed (Aiello & Chieffe 1999).

When diversifying internationally investors need to pay special attention to exchange rate risk. Many multinational companies deal with exchange rate risk with various hedging tools such as options, futures, forwards, and swaps. Another type of risk that can affect the international diversified portfolio is the political risk. The instability of foreign government as well as wrong monetary and fiscal policies can result in serious damage to the portfolio profits. However, in reality some political risk can be diversified and therefore when constructing the portfolio it is important to determine whether the political risk is diversifiable or not.

One of the essential researchers studying the international diversification benefits is Harvey (1995). Harvey (1995) has concluded that diversification results in shift of mean-variance efficient frontier. Based on this paper many researchers found the benefits of international diversification (Bekaert & Urias, 1996; De Roon et al. 2001; Fletcher & Marshal 2005). Very strong evidence of significant reduction of the shortfall risk for Canadian investors by diversifying internationally is found in Ho et al. (1999). However these results do not apply for the U.S. investors, who are unlikely to benefit from diversifying their portfolio internationally due to fact that their equity portfolio is already closely related to the international equity portfolio (Ho et al. 1999). The opposing standpoints towards the benefits of international diversification are discussed in Bhargava et al. (2004). Bhargava et al. (2004) develops the efficient frontiers graphs explaining the trends in international diversification for 22 year period from 1978 to 2000.



**Figure 2:** Efficient frontier 1978-2000 (Source: Bhargava et al. 2004).

Figure 2 shows that the efficient frontiers of various combinations of S&P 500 index with three international indexes: MSCI World Index, MSCI Europe Index and MSCI EAFE index. Bhargava et al. (2004) examine the benefits of international diversification by finding the best performance portfolios in the mean-variance framework and calculating the Sharpe ratio for each combination. For those investors interested with diversifying their portfolio with EAFE index (consisted of 21 major MSCI indexes from Europe, Southeast Asia and Australia), the minimum-variance portfolio is found by investing 38% in EAFE and 62% in S&P500. Maximized Sharpe ratio is found in case of portfolio containing 90% S&P 500 and 10% EAFE investment. Those investors that prefer to invest in European index, the minimum-variance ratio can be achieved by investing 60% into S&P 500 and 40% into Europe index. A maximum mean-variance return is found by investing 80% in the S&P 500 and remaining 20% into Europe index. If investors want to combine the S&P 500 with the World index, the minimum-variance portfolio is possible if the weight is 35% S&P 500 and 65% invested into world index. However, Sharpe ratio indicates that maximum reward-to-risk ratio is found in portfolio consisted of 100% S&P 500 investment. Therefore, some international diversification benefits are still possible for diversifying in the World Index due to the risk reduction benefits but investors will be better off by investing domestically (Bhargava et al. 2004). Bhargava therefore recommends the international diversification with World Index only for those investors with low tolerance of risk.



Based on Bhargava et al. (2004) findings, the benefits of international diversification are not complete and straightforward as researchers in 1970s thought so. Benefits from international diversification are still possible but steadily decreasing over time. The biggest benefit of diversifying internationally nowadays is the risk reduction. Furthermore, Sharpe ratio indicates that investing part of their portfolio in the EAFE and Europe markets, the investors from U.S will benefit. On the other hand, investing into World index cannot pass any benefits to the U.S. investors.

## **2.5. Financial Integration**

Financial market integration is by definition the process of unification of the markets. Integrated markets have unified risk-adjusted returns for similar maturity assets. Financial markets all over the world have experienced the increased integration in recent decades influenced by globalization, deregulation and advances in informational technology. Financial crisis across the world in 1990s additionally accelerated the process of integration among the markets. Integration process started among the developed countries. After the world major economies got more and more integrated, emerging and frontier economies started the removal of restrictions of pricing among many financial assets and therefore started their process of financial integration with developed countries. The result of that was more mobile capital across the countries additionally triggered by technological developments, electric payments and new communication systems (Reserve Bank of India 2006).

There are six major reasons why the financial integration among markets is important:

1. Integrated markets can lead the authorities to transmit vital price signals (Reddy 2003).
2. Domestic savings, investments and therefore the economic growth is promoted with efficient and integrated markets (Mohan 2005).
3. The possibility for domestic country's financial sector to develop and become the regional or even global financial center. This would not be possible if the markets are segregated (Reddy 2003)
4. Financial integration contributes to financial stability. This is the case due to increased competition, more efficient intermediaries and the allocation of resources among integrated countries (Trichet 2005).

5. Integrated markets lead to innovations and cost effective intermediations. Thus the financial services become more accessible to individuals and companies (Giannetti et al. 2002).
6. Market discipline and informational efficiency are improved as markets get more and more integrated
7. Integrated markets have better technology and payment systems due to their needs to achieve cost effective intermediation services (Reserve Bank of India 2006).

Different financial markets segments do not integrate in the same way since they trade various types of financial instruments. Some market segments are domestic in nature while the others are international. For example, foreign exchange and stock markets are international in nature because they deal with cross-border transactions and listing of foreign securities as well as the involvement of foreign investors in them. On the other side, money and credit financial market segments are domestic in nature, since they mostly involve banks as well as other financial institutions operating domestically. Other differences between financial market segments include various levels of risk profile of instruments or the liquidity. Therefore, financial integration depends on the investors' attitude towards the risk and the tradeoffs between risk and return relationship (Reserve Bank of India 2006). Finally, the integration process intensely depends on type of the financial market segment.

There are three dimensions of the financial integration: global, national and regional dimension (Reddy 2002). Global financial integration involves opening up the markets and financial institutions to free cross-border financial services and the flow of capital. Additionally, the barriers such as capital controls, withholding taxes, obstacles to movement of technology and people are removed (BIS 2006). One of the goals of global integration is to balance the national standards and laws between the countries (Reddy 2002). Second dimension of integration is the regional financial integration. Regional integration arises due to ties between the countries within a certain geographic region. It is by far easier achievable than the global financial integration due to tendency of market to concentrate in certain geographical center (Reserve Bank of India 2006). Regional integration is important for countries' economy because it also promotes the development of domestic financial markets. The easiest attainable dimension of integration happens at the domestic level. Domestic financial integration involves the linkages of different domestic financial segments. Some financial institutions such as the intermediaries help to accelerate this integration due to their nature of business of

operating concurrently in two or more market segments. For example, commercial banks work with savings and loan markets simultaneously (Reserve Bank of India 2006).

The financial integration process can be measured in many approaches that are divided into three categories: institutional or regulatory measures, quantity measures and the price based indicators (Reserve Bank of India, 2006). Regulatory measures include the existence of legal restrictions on trade across the borders or different domestic market segments. The effectiveness of these measures has been questioned by some researchers because they might not reveal the actual openness of the economy in reality (Prasad et al. 2006). Other regulatory measures are based on price and include cross-market spreads, correlations between the interest rates, volatility transmission, covered and uncovered interest rate parity, and asset price correlations (Reserve Bank of India 2006). Prasad et al. (2006) argue that price based measures are not good enough to measure the global and regional integration, especially for the emerging and frontier markets because prices sometimes move together due to common external driver or similar macroeconomic conditions and not due to the level of financial integration. Regulatory measures further include the liquidity and turnover measurements to measure the inter-linkages between the markets. These measures are quantity-based and they include gross capital flows, stock measures such as estimated gross stocks of foreign assets and foreign liabilities as share of GDP (Reserve Bank of India 2006).

At the theoretical level, the financial market integration has been postulated by the following economic principles: capital asset pricing model, law of one price, Black-Scholes pricing derivatives principle, arbitrage pricing theory, term structure of interest rates, purchasing power parity, interest parity conditions (Reserve Bank of India 2006). Capital asset pricing model is already described early in this thesis. Law of one price (LOOP), developed by Cournot (1927) and Marshall (1930) assumes that returns of identical assets should be comparable across the markets. Black-Scholes model allows the valuation of options through the futures contracts. It sets the linkages between the derivatives and the spot market of underlying assets. The arbitrage pricing theory (APT), which often serves as the substitute to the CAPM, (Roll & Ross 1980), and it is one period model in which stochastic returns of capital assets are consisted with a factor structure (Huberman & Wang 2005).

Financial market integration brings many benefits to countries but also some risks. Pros and cons of financial integration can be weighed in terms of sovereigns, financial

institutions and also individuals and corporations (Reserve Bank of India 2006). Mohan (2005) states primary benefits of domestic financial integration: higher economic growth, greater financial stability and the lower macroeconomic volatility. All of this is achievable since domestic financial market integration provides the country's economy with mobilization of savings, allocation of risks, absorption of external financial shocks and the governance benefits with market-based incentives. At the other hand, global financial integration brings following benefits: international risk sharing, capital flows benefits on domestic country's investments and growth, more efficient domestic financial system, and the overall greater macroeconomic discipline (Agenor 2001). Financial integration leads to improvement of resources allocation and lower costs of investment (Levine & Ross 1996).

The major risk of financial integration is the possibility of contagion. Contagion presence was widely studied during the 1990s and Late 2000s financial crisis around the world. Contagion problems during recent financial crisis caused many researchers to seriously question the global financial integration benefits stating that it ultimately brings the global financial instability (Stiglitz 2002; Bhagwati 1998). The treat of systematic instability is present in case of both domestic and global integration as complications from one market are easily transferred to another. Global financial integration brings the risk of following damages: domestic distortions caused by possible misallocation of capital flows, the loss of macroeconomic stability, pro-cyclical nature and high volatility of capital flows and the foreign banks penetration risks (Reserve Bank of India, 2006; Dadush et al. 2000). Risks associated with capital flows can be reduced in case that the major type of capital inflows is the direct investment which is less volatile than the other forms (Chuhan et al. 1996).

### **3. THE FINANCIAL CRISIS**

This chapter is divided into three sections. First section explains the financial crisis of late 2000s. The emphasis is on the crisis origins as well as the responsible parties for the crisis further development. Second part of this chapter describes the financial crisis more specifically – Lehman Brothers bankruptcy, which is the main event that prolonged the financial crisis and carried it out from US to the rest of the world. Finally, the last part of the chapter talks about relatively new term in finance – the contagion. Various definitions of financial contagion are given as the Late 2000s financial crisis contagious effects were described.

#### **3.1 Late 2000s Financial Crisis**

Following three parties are mostly responsible for the financial crisis development:

1. Treasury and Federal Reserve (together with governments and politicians of U.S. as well as some other European countries) actions of losing up the of interest rates decision making policy as well as the other financial safeguards and then intervening inappropriately to the red flags of approaching and undergoing financial crisis (Taylor 2009).
2. Financial institutions underestimating the risk and irresponsibly chasing the bigger profits.
3. Millions of people pursuing the “American dream of home-ownership”

Since hundreds of years ago the monetary excesses started causing the economy's booms and inevitably later on – the busts. Just like it happened many times before, this financial crisis was caused by economic boom - specifically the housing boom and its bust (Taylor 2009). According to Clougherty (2008) the financial crisis originated back in 1977 when the US government passed anti-redlining laws about the mortgage market. Later on around the 2000 the dotcom bum went bust driving down the stocks and sparking a recession. Then the attacks of September 11, 2001 occurred. U.S. economy suffered the major disturbance and breakdown during that time. To help the economy to recover the U.S. central bank - Federal Reserve cut down the interest rates repeatedly. With low interest rates banks were able to land the money much easier and people were able to borrow and spend

In the roots of the “American dream” which is the attribute for the prosperity and success pursued by most of the Americans is the home-ownership. Due to the Federal Reserve policy of constantly decreasing the mortgage rates, millions of Americans started pursuing their dream with buying homes that they realistically could not afford. Financial institutions realized that enormous profits could be made from this and started creating the sub-prime mortgages ignoring big risks involved (Taylor 2009). Therefore, the combination of excess borrowing by the ordinary people, the lack of strong decisive Fed policy and increasingly risky investments by the financial institutions have led to the development of the Late 2000s financial crisis (Taylor 2009).

From 2000 until 2006 housing prices doubled. Detecting the potential profits to be made, banks and mortgage companies began offering mortgages to low income part of the population – which was very risky. Due to loose regulatory environment caused by wrong economic policy of U.S. government of promoting the home-ownership, mortgage brokers across the U.S. were offering mortgages to people with little or in some cases no income at all. Furthermore, banks and mortgage companies were able to transform the loans they were making into commodities. Therefore, banks were selling the large pools of mortgages to some bigger financial institutions who were putting them together to make new tradable securities. In order to protect themselves from the risky loans and sub-prime mortgages the investment companies packaged them into collateral debt obligations. Collateral debt obligations (CDOs) are basically derivatives that are traded forwardly. CDOs can be observed as ‘special purpose vehicle which makes the illiquid assets tradable (Longstuff & Rajan 2008). These derivatives are backed by the puddle of bonds, stocks and also some other less liquid private assets such as subprime home equity loans, credit card receivables, commercial mortgages, student loans etc. (Longstuff & Rajan 2008; Richardson 2005). Based on the maturity and risk variation these loans are divided into ‘slices’ or ‘tranches’. Higher the risk means that CDO will pay more to the investor.

Millions of securitized loans were fused together and sold to investors in markets all over the world. At first it was a very profitable deal with high returns and little apparent risk due to the constant rise of the housing prices in U.S. But the problem was that in reality, out of enormous number of mortgages being sold, in 2006 for example more than 20% were high risk. Very risky mortgages that got sold to investors were labeled by the rating agencies as “very good”. Those sub-prime and other mortgages packed into mortgage-backed securities underestimated by the rating agencies were in fact securities of great complexity (Taylor 2009). Taylor (2009) explains them as a “Queen

of Spades” problem with the game of Hearts. In the game of Hearts, you don’t know where the Queen of Spades is and you don’t want to get stuck with it. Therefore, with millions of subprime mortgages, there are the bad and highly risky ones, but investors did not know where they are. The credit rating agencies underestimated the sub-prime mortgage risk most likely due to their complexity (Taylor 2009). Once people begun to default on their mortgages the big problem started. Due to CDOs misleading complex nature, banks were not sure anymore of how much liability they were exposed to. Therefore, banks decided to solve this problem by stop making loans. As a result, true systemic financial crisis was triggered for the first time since the Great Depression of 1929.

In October 2007, global equity markets had an all-time high market capitalization rate of more than 51 trillion dollars (Thomson DataStream 2012). Next 17 months after the October 2007 represent the largest destruction of equity value in the world’s history. The equity market capitalization of the world’s markets has dropped over 56% (22 trillion dollars) while the equity value has been reduced by 29 trillion dollars (Thomson DataStream 2012). The loss in wealth of equity holders equals of 50% of the world’s GDP value for the year 2007 (Bartram 2009).

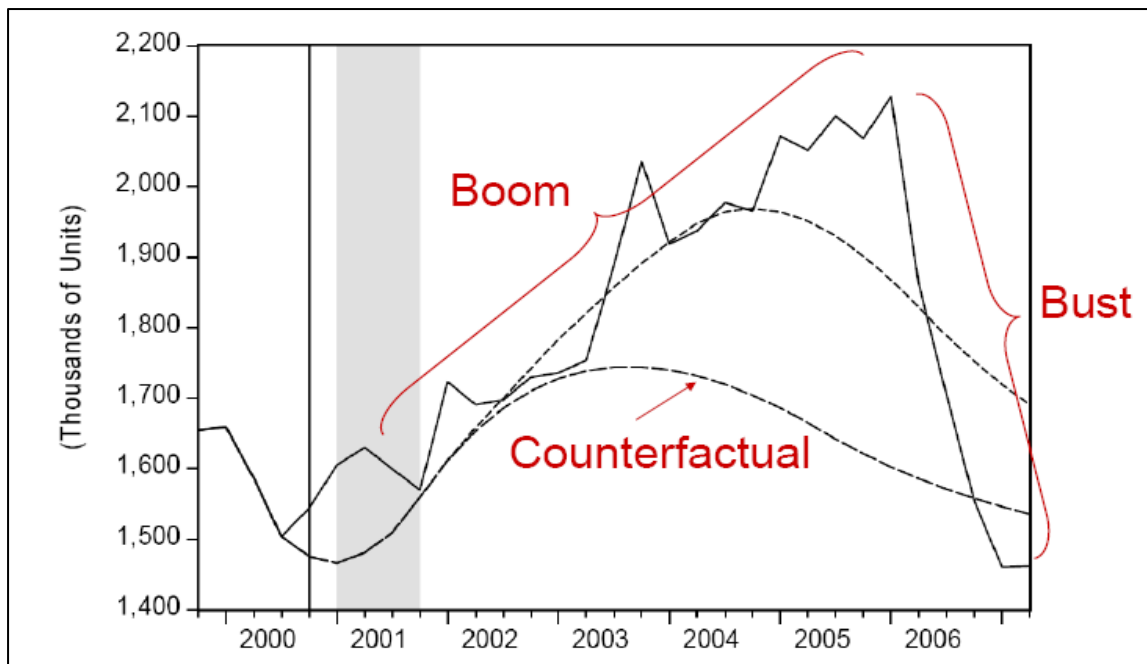
As financial crisis became acute in August 2007, the U.S. government’s wrong policy helped its further development (Taylor 2009). There are many wrong decisions made by the policy makers of Treasury, Fed and U.S. government that further prolonged the crisis. First wrong decision by the policy makers was the wrong response on August 9<sup>th</sup> and 10<sup>th</sup> 2007 - the record increase of three-month Libor and Overnight Index Swap (OIS) spread. Instead of focusing on the counterparty risk problem, policy makers saw this as the liquidity problem and unsuccessfully tried to solve it by providing more liquidity (Taylor 2009). Instead, the appropriate policy here would be focusing on the quality and transparency of the balance sheets of banks by providing more capital to financial institutions and banks require more transparency, and dealing directly with the mortgage defaults as the housing prices weakened. Second wrong intervention that further prolonged the financial crisis was the introduction of the term auction facility (TAF) by the Fed. TAF was introduced increase the flow of credit and lower the interest rates by decreasing spreads in money markets. However, despite little early success TAF did not make any difference in the economy in the long run and the crisis continued (Taylor 2009). Another unsuccessful government intervention was the passing of Economic Stimulus Act in February 2008. This act sent 100 billion U.S. dollars to individuals and families in order to boost the spending and restart the

economy. However, people did not spend much of this money and the economy did not experience the jump-start as planned. Finally, a policy response of sharp cut in the federal funds rate in the first six months of the crisis did not help in stopping progress the crisis as well. The federal funds rate was reduced from the 5,25% in August 2007 to 2% in April 2008. Even the final effects of this policy was not enough researched, it appears that the only response in the economy was the depreciation of U.S. dollar and the huge rise in the oil prices (Taylor 2009). Oil prices doubled from 70 dollars per barrel in August 2007 to over 140 dollars in July 2008.

The global financial communities seem to believe that the prices will forever keep on going up. Of course this cannot be the case in reality, so the bubble burst. In 2007 mortgage companies and banks with many risky loans started to go bankrupt first. Then the biggest financial institutions such as investment banks in U.S. were challenged with the same problem. Basically it was a credit shortage and cash flow problem. Banks and other financial institutions that profited mostly on borrowing now did not have enough liquidity to cover up the losses and survive this treat. As the word spread very quickly all over the world, many banks globally got affected and share prices plummeted. (Clougherty 2008)

The rating agencies underestimated the risk of CDOs which further helped the crisis to develop more. Monetary excesses were the main cause of the late 2000s financial crisis. (Taylor 2009). Taylor (2009) criticizes the Federal Reserve for abandoning the policy it followed the previous 20 years of good financial performance. He found the clear evidence of monetary excess in the period preceding the housing boom caused by the Fed. An extra easy policy by Fed with low interest rates directly caused the housing boom and bust. (Taylor 2009).



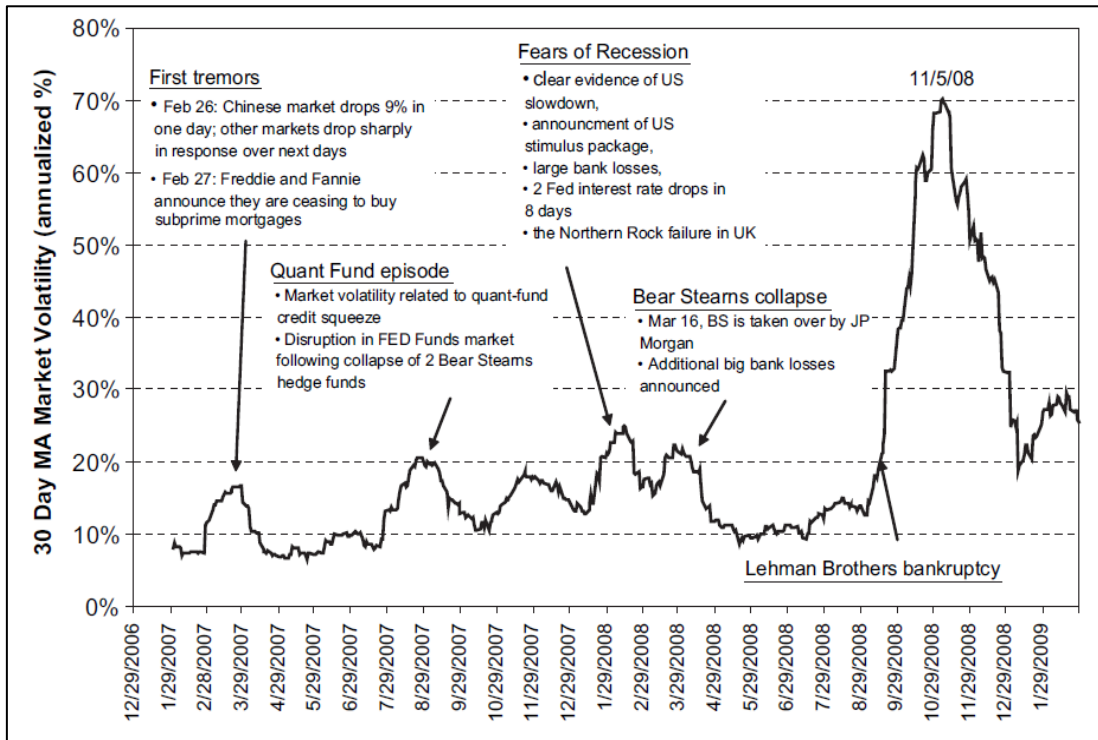


**Figure 3.** The Boom-Bust in Housing Starts Compared with the Counterfactual -The line with shorter dashes shows model simulations with the actual interest rate. (Source: Taylor 2009)

The line labeled “counterfactual” in this graph is a statistical estimation of what would have happened if the Federal Reserve has followed the common monetary policy it used since the 1970s. According to this estimation the boom and bust of the housing market would never happened in case that Fed did not use the unusually low interest rates policy (Taylor 2009). This extra easy government policy of deviation from historical regularities was directly responsible for the development of the housing boom and bust not only in U.S. but in other countries as well. It was the case that the housing booms were largest in countries with largest deviation policy from historical rules. Spain was the European country with largest deviation from the regulatory policy and therefore also the country with the housing boom in Europe (Taylor 2009).

Figure 2 shows the world’s market volatility on annual basis. It is very clear how much the Lehman Brothers bankruptcy affected the stock markets around the world. The volatility rose to massive 70% after the September 15<sup>th</sup>, 2008 while the “normal” levels of volatility on annual basis are 10-12%. Next 35 days following the Lehman Brothers bankruptcy announcement are the best representation of Late 2000s financial crisis of stock markets. In this period the price volatility was skyrocketing while the price levels

were falling dramatically fast. It is interesting how after November 2008 the volatility fell to the twice as pre-crisis levels very quickly, nearly as fast as it rose after September 2008. Despite this, the equity continued to decline due to the fact that the collapse has already been triggered with the credit crisis which now turned into the rear of real demand crisis. (Bartram 2009)



**Figure 4.** World market volatility 30 day moving average annualized standard deviation of total index on the DS World Market (Source: Bartram 2009)

### 3.2. Lehman Brothers Bankruptcy

As the mortgage crisis followed by the banking crisis started in early 2007, the real collapse of the equity market happened with the bankruptcy of Lehman Brothers in September 2008 (Bartram 2008). On September 15, 2008 Lehman Brothers announced drop into chapter 11 protection – the bankruptcy. This announcement was the biggest bankruptcy in the world's history (10 times bigger than Enron) and the triggering point for the Late 2000s financial crisis. September 15 announcement had the catastrophic consequences for the stock markets and the global economy. One year after crisis

started it was not only prolonged but worsened with events in September and October of 2008 (Taylor 2009). The financial panic that followed the announcement of Lehman Brothers bankruptcy caused universal and severe impact to the world's economy. From September 15 until the end of the year 2008, most of the stock indices fell down so sharply that they were at 50% or even less compared to their 2006 levels as well as down 60% from their heights (Bartram 2009). Therefore, this date is considered as the main event of the late 2000s financial crisis.

Lehman Brothers experienced the rapid growth in years preceding the crisis as it was expanding mostly through credit default swaps - an insurance against borrowers defaulting on loans. As the economic environment was loosely regulated due to the Fed policy makers, Lehman Brothers grew quickly taking the excessive risk. During 2007 Lehman Brothers was the largest underwriter of mortgage loans in America. It borrowed much more money than its biggest competitors on Wall Street. Lehman Brothers had a fairly insignificant amount of capital compared to the amount of money they owed to investors.

Lehman's huge property investments were dangerously exposed with a crash in a market as people started struggling with their mortgage payments and the increased rates. In June 2008, Lehman Brothers announced the second quarter loss of 2.8 billion dollars. US government decided not to give a bailout to Lehman. Until today it is unclear why US government bailed other two big financial institutions: Fannie Mae and Freddie Mac, but did not help the Lehman Brothers. Therefore, only two of Lehman's rivals were able to help: Bank of America and Barclays. However, on September 15 Bank of America announced that it acquired Merrill Lynch for 50 billion dollars leaving Lehman Brothers with only one choice: to seek the help from the Barclays. As the deal between Lehman Brothers and Barclays failed, the biggest bankruptcy in the history occurred.

By the end of Monday's trading (September 15, 2008) 700 billion dollars have been lost in the global stock markets. During the same day, Dow Jones, one of the leading stock exchange indexes had fallen by 500 points. It was the biggest fall in a day since the attacks of September 11, 2001. Over the four week period, the 28 days between the bankruptcy of Lehman Brothers and the announcements of recapitalization packages for banks around the world in October there the extraordinary loss of confidence and a financial panic occurred. Allowing the Lehman Brothers to go bankrupt was a tremendous mistake by the US government according to many researches. The amount

of money that would have taken to save Lehman Brothers was miserable compared to the destruction that followed the Lehman bankruptcy and the complete shutdown of the credit markets around the world. Lehman Brothers was the catalyst for the market crash in 2008. The fall of Lehman Brothers brought the global financial system down to the bottom. Many researchers ask today: “*Should the US Treasury provide the bailout for Lehman Brothers?*”

### 3.3. Contagion and Financial Crisis

“*There is no consensus of exactly what constitutes contagion or how it should be defined*” (Forbes & Rigoboom 2001). Unfortunately, there is no universally accepted definition of financial contagion today. According to some researches the contagion occurs when the shock from one country is transmitted to other countries even if the cross-market relationships stay significantly unchanged. The others, however, argue that only the certain type of transmission mechanisms of shocks across the countries could cause the financial contagion (Forbes & Rigoboom 2002). Some researches simply study the contagion by estimating the cross-market correlations in stable versus the crisis periods. An increase in the correlations between the markets in crisis periods is sometimes simply used as a proof of contagion (Lee & Kim 1993). However, these four facts are usually defined in order to explain when the contagion occurs:

1. Spreading the stock price decline across countries
2. Increasing return volatility in crisis periods
3. Generally higher covariance
4. Higher correlations in times of financial turmoil.

Contagion is also defined as excess correlation, specifically the correlation over and above of economic fundamentals (Bekaert et al. 2005). Forbes & Rigobom (2002) define the contagion as increase in cross-market linkages between the countries after a shock occurred in one (or group) country. Additionally, Forbes & Rigoboom criticize the previous researches about the financial contagion and make a significant distinction between the contagion and interdependence. Therefore, financial contagion is basically the cross-country spillover of financial crisis. Contagion occurs through two channels: real and information channel (Reserve Bank of India 2006). Real channel works as a “domino effect” with the real exposures on participants operating in different financial

market segments of the economy. Contagion spreads with information channel due to lack of accurate and timely information.

There is a big body of literature about the financial contagion. Financial crisis of 1990s such as Mexican crisis in 1994, the “Asian flu” crisis in 1997, and the “Russian virus” crisis in 1998, as well as 1987 US stock market crash are investigated by many researches because of their contagious effects on countries all over the world. Samarakon (2011) examines the transmission of the shock from the US to the equity markets around the world. Specifically, the effects of interdependence from contagion of US financial crisis on European frontier equity markets are investigated. Samarakon (2011) found a bi-directional but asymmetric interdependence and contagion between the US and equity markets around the world. Frontier markets showed the lower level of contagion with the US than the emerging markets. However, it is proven that the frontier markets are influenced by the US market much more during the crisis times as well as that the frontier markets showed more contagious effects from the US shocks than the emerging markets. Additionally, the evidence of contagion from the US stock market on equity markets of Serbia and Croatia is found (Samarakon 2011).

King & Wadhvani (1990) observed the contagion and volatility spillovers effects of US stock market crash in October 1987. They give a proof that the US stock market crash caused contagion of UK and Japanese stock markets. Additionally, they conclude that a “mistake” or a shock in one market is transmitted as a contagion around the world very easily despite the widely different economic situations. Volatility spillovers are very likely to happen in turmoil periods (King & Wadhavani 1990). Beale (2005) studies the magnitude of volatility spillovers from the US to European equity markets in 1980s and 1990s. Beale (2005) concludes that the contagion occurred between the US and European countries during the times of high world market volatility. Moreover, the shock spillover intensity and contagion between the US and Europe is increased due to the three factors: trade integration, equity market development and low inflation (Beale, 2005). The Mexican crisis in 1994 and its contagious effects are studied by Bekaert et al. (2003). This study finds no evidence of financial contagion from the Mexican crisis between the US, Europe, Latin America and Asia. However, the economically significant increase in correlation is found during the Asian crisis among the Asian countries.

The contagious effects of the US Sub-prime crisis is investigated by many researches (Samarakon 2011; Aloui et al. 2011; Chan et al. 2011; Guo et al. 2011; Pesaran &

Pesaran 2010, Longstaff 2010; Dooley & Hutchison 2009). Dooley & Hutchison (2009) conclude that the linkages between the US stock market with other emerging markets around the world got much stronger after the autumn 2008 and announcement of Lehman Brothers bankruptcy. Specifically, the relationship between US and Mexico is extensively investigated and the linkages in returns are found to be at much higher rate during the crisis time.

Longstaff (2010) finds a strong evidence of contagion effects on the stock returns, treasury yields, and the corporate bond spreads due to the sub-prime debt collateral obligations during the Late 2000s financial crisis. The contagion from sub-prime crisis was spread mainly through the liquidity and risk-premium channels (Longstaff 2010). Chan et al. (2011) defines the “crisis” period as an economic decline time where the stock returns are sharply negative, the volatility is high and the contagions occurs between stock, oil, and real estate. A time-varying dependence between the world largest emerging markets and US are found in Aloui et al. (2011). The dependency with the US stock market is found to be at higher rate for countries with commodity-price markets while those countries with finished-products export oriented markets showed the lower level of dependency with US.

## **4. FORMER YUGOSLAVIAN COUNTRIES**

This chapter points out the economic condition in each former Yugoslavian country. The challenges and issues are discussed as well as the progress made towards European Union succession during the independence period. The effects of Late 2000s financial crisis on each country is acknowledged with the predictions for the future. Additionally, the special emphasis is made to the each country's stock exchange – the history, present state and international cooperation. The economic indicators for the period from 2000-2010 are summarized in table for each country separately.

### **4.1. Serbia**

During the Yugoslavian civil war (1992-1995) Serbia was exposed with the economic and political global sanctions. Therefore, even the civil war was not undergoing on the Serbian territory the Serbian economy suffered extreme downturn. Between the 1993 until the end of the civil war in 1995 Serbia suffered one of the greatest hyperinflation the world has ever seen. Only between October 1, 1993 and January 24, 1995 due to the global sanctions, civil war in former Yugoslavia, as well as wrong government fiscal policy, the prices in Serbia increased by 5 quadrillion percent (Lyon, 1996). The exchange rate of Deutsche Mark and Serbian Dinar was 1 DM = 1 million Serbian Dinars on November 12, 1993, while the exchange rate on December 29, 1993 was 1 DM = 950 billion of new Serbian Dinars. Therefore, the inflation was nearly 100 percent a day (Watkins 1996). The inflation kept uncontained rise and reached the highest levels on January 4<sup>th</sup> 1994 when the exchange rate was 1 DM = 6 trillion Dinars (Watkins 1996).

However, today the economic and political environment in Serbia is rather different as the country moved on from the rough times. The new democratic regime is leading the country towards the European Union as of March 2012 Serbia is an official candidate member country to join the EU. The negotiation process towards getting the official status of member state is expected to start later this year.

Government is nowadays making all necessary changes to become a modern European country. In years preceding the global financial crisis in Late 2000s, Serbia experienced the rapid growth in terms of per capita, international competitiveness, and foreign direct investment (FDI) allocation (Kekic 2005). Serbia is a country with a huge potential for economic development due to its natural and mineral resources as well as its strategic

location in Southeast Europe and Western Balkan with great access to European markets. It has the great geographical position for developing a transportation hub (Rec 2009). Serbia is attractive to many foreign investors due to undergoing privatization in recent years. Most of the foreign direct investment boost was related to the privatization in banking and telecommunications sectors. The banking sector is almost completely in the hands of west European banks (Rec 2009). Restructuring and privatization especially paid off in case of telecommunication as well as small and medium-size companies. Economy suffered the hard hit by the Late 2000s financial crisis, but is already slowly recovering with the growth of 2,9% which is an increase from 1,7% in 2010. A new long-term economic plan is adopted by the government with a goal of quadrupling the exports in next ten years and heavy investments for basic infrastructure (Central Intelligence Agency 2012).

Some of the issues Serbia is facing nowadays are negotiations about its southern province Kosovo and its international status. Additionally, the problem is a country's current account deficit, due to the imports boost in recent years and the government debt which is also increasing drastically. This trend is evident in many European countries in recent years. Another issues are high unemployment rate, stagnant household income, high government salaries expenditures, growing need for government borrowing and rising the public and private foreign debt (Central Intelligence Agency 2012).

The Belgrade Stock Exchange, established in 1894, was one of the oldest in the region. Throughout the history of Belgrade Stock Exchange mostly traded securities were the ones issued by the government since the people trusted the government more than the public companies. The exchange suffered big downturns during the World War II as well as the Civil War in former Yugoslavia in 1990s. However, in 2000 the big step forward was made at the exchange as shares from the previous privatization processes were included in secondary trading. In 2001 the Republic of Serbia government bonds were introduced at the exchange in order to cover the government debt which further boosted the domestic capital market. The international cooperation and linkages with the world's developed stock markets and those in the region were established in 2003 and 2004, when the first index of Belgrade Stock Exchange was established as well.

Today Belgrade Stock Exchange puts lot of emphasis on the international integration and reconsideration. The exchange is nowadays developing on the global standards with constantly improving efforts and striving to adopt and implement the best solutions in stock market industry. Belgrade Stock Exchange actively participates in leading



international associations and that proves its creditability as well as the quality of legislative standards that the exchange is built on today. The exchange in Belgrade is a full member of Federation of Euro-Asian Stock Exchanges (FEAS), associate member of the Federation of European Exchanges (FESE) and World Federation of Exchanges (WFE). Additionally in 2007 the Memorandum of Partnership between the stock exchanges from South-East Europe was signed between the Belgrade Stock Exchange and Ljubljana (Slovenia), Zagreb (Croatia), Banja Luka and Sarajevo (Bosnia and Herzegovina), Montenegro, NEX Montenegro, and Skopje (Macedonian Stock Exchange).

The benchmark for the Belgrade Stock Exchange is the BELEX line index which is a free-float market capitalization weighted index. The participation in BELEX line index is limited to 10% for the issuers with large market capitalization due to the influence issue (Rec, 2009). The total turnover for year 2011 is 25 billion RSD which is equivalent to 246 million euros an amount about 10% more than in 2010. The highest turnover was in 2007 just before the financial crisis hit of 165 billion RSD or 2 billion euros. Shares accounted for the 91% of total turnover while the bonds of the Republic of Serbia accounted for remaining 9%, a trend that is repeating from previous years. The foreign investor participation in 2011 for total share turnover was 46% and for total bond turnover 8%. Foreign investors participated progressively more and more in total turnover until the early 2007 when due to the increasing inflow of domestic investors slowed their participation percentage was slightly lowered. Foreign investors focused primarily on trading in foreign currency savings bonds whereas the trading in shares was significantly lower (Rec, 2009).

## **4.2. Slovenia**

Slovenia is a country with great strategic position between the Western and Eastern Europe as well as Central Europe and Balkans. After gaining its independence in 1991 Slovenia did not experience express economic and political reforms due to the fact that it was the most productive Yugoslavian republic with a strong market ties with Central and Western Europe. Slovenia is nowadays developed more than any other former Yugoslavian country with excellent infrastructure and well educated workforce (Central Intelligent Agency 2012). Slovenia joined the European Union in May 2004 and was first of new EU states from Central and Eastern Europe and the Baltics that adopted the euro on January 1, 2007. Additionally, Slovenia is a member of Central European Free

Trade Agreement (CEFTA) since 1996 and the founding country of World Trade Organization (WTO).

Slovenia is a model country for the stability and economic success for the all other former Yugoslavian countries also managing to reach highest per capita GDP in central Europe (Central Intelligent Agency 2012). Slovenian economy is very open as the government maintained the highest level of state control from all of the EU countries. It is the high-income country with steady economic performance. GDP per capita is \$28,200, the highest by far of all other former Yugoslavian countries. In 2004 Slovenia became the first of the transition economies that moved from the borrowing to a donor country to World Bank, as the accession process of joining the Organization for Economic Co-operation and Development (OECD) begun in December 2007.

Great export performance led to positive growth of Slovenian economy year after year. Slovenia exported high value added products to the EU markets specifically Germany, Austria, Italy and France. Recent years exports have increased particularly in auto and pharmaceutical industries (Rec 2009). Additionally, Slovenia exports to all former Yugoslavian countries as well as the other Southeast European markets (Mates and Mrsnik 2008). Another characteristic of Slovenian economy is surprisingly low foreign direct investment compared to other countries in the region. Besides the year 2002 when the net FDI to GDP was 7%, average FDI to GDP was about 1% (Rec 2009, The World Bank 2012). Banking sector in Slovenia is the most developed in the region and constantly growing. Banks are mostly domestically owned. However, Slovenian economy suffered a big downturn by the Late 2000s financial crisis, as the exports and industrial production were reduced by 8%. Traditionally lowest unemployment rate in the whole region of about 6% since 1997 is now on the record high of more than 10% in 2010 and is increasing (Central Intelligent Agency 2012; Rec 2009).

Ljubljana Stock Exchange was established in 1989. In 2008 Vienna Stock Exchange (Austrian Stock Exchange) acquired 81.01% share of the Ljubljana Stock Exchange. Ljubljana Stock Exchange is full member of the Federation of European Securities Exchanges (FESE) as well as World Federation of Exchanges (WFE). Additionally, Ljubljana Stock Exchange signed the Memorandum of Partnership which is a cooperative agreement of promoting a regional market to international investors with other Southeast European equity market exchanges – Belgrade, Macedonia, Zagreb, Banja Luka, Sarajevo, Montenegro and Nex (Rec 2009). From December 2010 Ljubljana Stock Exchange became integrated into the international stock market by

starting to trade on Xetra® - leading international trading platform used by over 250 financial firms and 4,800 stock brokers in 18 European and one Middle East country. Leading index of Ljubljana Stock Exchange is SBI TOP introduced in 2006. This blue-chip index serves as Slovenian capital market benchmark index measuring the performance of high capitalized and the most liquid stocks listed on the Ljubljana Stock Exchange. SBI TOP is price index which is weighted by the free-float market capitalization. The adaptation of euro in 2007 helped the Exchange to grow faster as the foreign exchange risk was eliminated and foreign investors investing into the Slovenian companies were attracted (Rec 2009).

In order to increase the quality of information on the Exchange as well as to ease the comparison of products and segments with the European Stock Exchanges the new market segmentation was introduced in May 2008. Equities, bonds, funds, closed-end funds and the structured products were introduced as the new divisions on Ljubljana Stock Exchange. Specifically, the equity market was divided into Prime market, Standard market (official) and the Entry market (semi-official) (Ljubljana Stock Exchange 2012 - SEOnet). According to the new division, largest companies with the most liquid track record are listed at the most prestigious Prime Market (Rec, 2009). The average monthly turnover of Ljubljana Stock Exchange for year 2010 was 41 million euros, while the equity market capitalization was 7 billion euros.

### **4.3. Croatia**

Croatian economy suffered a big hit during the civil war 1992-1995 as its government managed to move from planned to market economy after the declaration of independence. That helped Croatia to double the incomes as well as to receive an investment-grade rating (Rec 2009). Moderate and steady GDP growth especially between the 2000 and 2007 of 4-6% helped Croatia to become a modern European country, currently on the doorstep of the European Union. On December 9, 2011 Croatia signed the treaty to become a 28<sup>th</sup> member of the EU. Therefore, the accession of Croatia into the European Union is scheduled to be on July 1, 2013.

Croatian economy is mostly service-based with GDP (purchasing power parity) of \$78.09 billion in 2010. The GDP growth in Croatia is mostly directed by the tourism and the credit-driven consumer spending (Central Intelligence Agency 2012). Additionally, the real GDP growth occurred due to the gains in competitiveness, productivity and the

access to external liquidity (Rec 2009). Croatian currency Kuna (KN) stayed stable since its introduction. Similar to Serbia, the banking sector in Croatia is mostly owned by the foreign banks (about 90%). Foreign banks in Croatian banking sector are mainly from Italy and Austria (Rec 2009). Corporate borrowing in Croatia was at high rate due to the local banks foreign parents' external financing. This corporate borrowing significantly decreased with the Late 2000s financial crisis (Rec 2009). Inflation in Croatia stayed low during this period. Croatia became a member of WTO and CEFTA and like Slovenia, opened its markets to the world. That resulted in rapid growth of Zagreb Stock Exchange. Additionally, Croatian government re-launched the cooperation with all the former Yugoslavian countries as well as other countries in the region of Southeast Europe.

Late 2000s financial crisis left a big mark as Croatian economy hit the recession in 2010. Despite the predictions that the economy will recover in 2011 in reality that was not the case. Economic indicators show the sluggish recovery with the annual growth of Croatian economy of only 1.5 – 1.8%. Croatian economy suffered mostly due to its high foreign debt, weak exports sector, and over-reliance on tourism revenue. Some other issues that Croatia is facing nowadays are the high unemployment rate of almost 18% in 2010, uneven regional development as well as the growing trade deficit. However, the EU accession should lead to further acceleration of fiscal and structural reforms as the long-term growth prospectus for Croatian economy remains strong (Central Intelligence Agency 2011).

Zagreb Stock Exchange was established in 1991 and today is trading the stocks of Croatian companies, commercial bills and bonds. The exchange grew rapidly since the introduction of the electronic trading system in 1994. From 1995 until 2000 market capitalization grew almost 10 times or 982.6%. On its peak in 2007, Zagreb Stock exchange accounted for more than 52% of the regional market capitalization and 39% of total regional trade (Rec 2009). The official index of Zagreb Stock Exchange and the benchmark is CROBEX, published on September 1, 1997. It is weighted by the free float adjusted market capitalization (Zagreb Stock Exchange 2011). Any company listed can be weighted up to 15% of the CROBEX index capitalization. CROBEX today includes stocks of top 25 companies on the market.

Zagreb Stock Exchange is intensively working with Organization for Economic Cooperation and Development (OECD) and Dow Jones on planning the principles of corporate governance. The Exchange is a member of Federation of Euro-Asian Stock

Exchanges as well as Federation of European Stock Exchanges (FESE). Zagreb Stock Exchange worked together with Belgrade and Ljubljana Stock Exchanges on developing the blue chip indices. Additionally, the Stock Exchange in Zagreb is an official partner with other former Yugoslavian countries' exchanges: Belgrade, Ljubljana, and Macedonia (Rec 2009).

#### **4.4. Bosnia and Herzegovina**

Bosnia and Herzegovina is the central country of former Yugoslavia. This position caused Bosnia to suffer the most damage from the civil war in Yugoslavia (1992-1995). The fact that the most of the war destruction occurred on its territory caused its economy to hit the bottom with the real GDP down by 80% and the 2 million of country's population (about one half) to become refugees (Rec 2009; The World Bank 2011). With the end of the civil war and Dayton Agreement in 1995, the territory of Bosnia and Herzegovina is divided into two political entities: Republic of Srpska (Republika Srpska – RS) and the Federation of Bosnia and Herzegovina (Federacija Bosne i Hercegovine). Both of these entities have its own government, president, administration, and the extensive power at local level. This complicated duplicative governmental structure is getting in the way to the economic growth and development in the post-war years.

Bosnia is nowadays among the poorest countries in Europe. The national interests between two opposing entities are something that the political parties and the divided governments are striving for. However, in recent years some progress was made for Bosnia and Herzegovina. The centrally planned economy moved to market economy. The wood industry, together with machinery and the producing of mining and base metals has been growing in recent years. The indirect taxation of a value-added tax (VAT) that is collected by the state rather than by the political entities has been introduced in 2005 (Rec 2009). Official currency of Bosnia and Herzegovina is Konvertibilna Marka (KM). KM is pegged to euro with the exchange rate of 1KM = 0.51129 (Bank of Bosnia and Herzegovina 2011). Due to the fact that the Konvertibilna Marka is pegged to euro the issue of high inflation is resolved for Bosnia. The most developed area of Bosnian economy is the banking sector since the banking laws between two entities are well synchronized. Banking sector is privatized by foreign investors, a trend followed by most of the countries in the region. Financial crisis has a vast negative impact on the banking sector in Bosnia.

The accession to European Union is one issue that the both political entities are agreeing upon. The EU accession is very welcomed and popular in both political entities of Bosnia and is something that Bosnia is giving big efforts to be closer to. The Stabilization and Association Agreement (SAA) with EU is signed in 2008 which is the first step towards getting a status of European Union membership.

Major issue that Bosnia is facing nowadays is the “grey economy” which is very large compared to other European countries. Rec (2009) suggests that GDP of Bosnia could be increased about 20% if the underground economy could be accounted for. Additionally, the unemployment rate is the highest in the region. However, due to the large grey economy, the unemployment is actually much lower than the official numbers suggest.

Bosnia and Herzegovina has two stock Exchanges, one in each political entity:

1. Banja Luka Stock Exchange (Banjalucka Berza) – BLSE. BLSE is founded in 2001 as the first stock exchange index – BIRS was founded in January 2004. BIRS is price weighted index and includes 12 largest companies listed on the Exchange. The largest company is Telekom Srpske (Telecom of Republic of Srpska). Banja Luka Stock Exchange is a full member of FEAS – Federation of Euro-Asian Stock Exchanges, and the correspondent member of WFE – World Federation of Exchanges. The Exchange signed the Cooperation Agreement with Wiener Börse in June 2006 and with Venna Stock Exchange in May 2008. Banja Luka Stock Exchange cooperates with all the stock exchanges of Former Yugoslavian countries as well as the other countries in the region. The total turnover for the Exchange in 2010 was KM 176,195,081 or 90,712,750 euros. This turnover is close to the one in 2009 but lower than in 2007 and 2006, which can be explained with the influence of the Late 2000s financial crisis (Banja Luka Stock Exchange 2012).

2. Sarajevo Stock Exchange (Sarajevska Berza) – SASE. The exchange was founded in 2001. Since it commenced trading in April 2002, the Exchange grew drastically (by 20 times) in first 3 years. Later years brought the steady growth. When the Exchange opened the trading took place only once per week. As the Exchange grew, the trading nowadays takes place Monday to Friday. Currently only equity shares are traded at the exchange due to the fact that the capital market in Bosnia is very young (Rec 2009). The main index of the Exchange is SASX-10 which is the price index composed of the 10

biggest companies on the Exchange in terms of market capitalization and the frequency of trading. SASX-10 was developed in 2006 and is fully market capitalization weighted index, with individual issuer limited to 20% weight. Sarajevo Stock Exchange is a full member of FEAS – Federation of Euro-Asian Stock Exchanges since November 2007. Additionally, the cooperation with Wiener Börse and Vienna Stock Exchange is active since 2006.

#### **4.5. Montenegro**

Following the breakup of Social Federative Republic of Yugoslavia, Montenegro and Serbia formed its legal successor called Federal Republic of Yugoslavia in 1992. This country changed its name to Serbia and Montenegro in 2003, as on June 3, 2006 Montenegro officially declared the independence from Serbia. Today Montenegro is a member of International Monetary Fund and the World Bank. In October 2007 Montenegro signed the Stabilization and Association agreement with the European Union. The country already gained the status of candidate in December 2010 as the accession dialogue is expected to begin this year. Additionally, Montenegro is in process of gaining a membership of the World Trade Organization (Central Intelligence Agency 2012; The Heritage Foundation 2012).

Even during the time of FR Yugoslavia and Serbia and Montenegro, Montenegrin government disconnected its economy from federal control of Serbia and introduced strong privatization. The most dominant industry has been privatized - the aluminum plants (Central Intelligence Agency 2012). In addition, the financial sector and most of the tourism sector has been privatized as well. With realized privatization of the economy the capital market sector became more important and developed (VIP Broker Macroeconomic Data 2012). In order to speed up the integration into the international flows, a new set of laws and regulations that are well-matched with those of European Union were set after the country gained the independence (VIP Broker Macroeconomic Data 2012). Since January 2002, Montenegro's official currency is euro, despite the fact that Montenegro is not a member of Eurozone. The use of euro is probably the biggest step of economic reforms towards the international integration made by Montenegro so far as it gives Montenegro a certain level of economic stability in monetary domain by low inflation rate.

The biggest challenges Montenegrin government is facing are the high unemployment rate, highly developed black market and the regional inequalities in development. Additionally, the Late 2000s financial crisis hit the Montenegrin economy very hard. The negative influence of financial crisis is especially visible with credit crunch and declines in aluminum exports as well as the real estate sector (Central Intelligence Agency 2011). Additionally, the official index of Montenegro Stock Exchange – MONEX20 had a drop of almost 20% in the period from January 1, 2011 until June 30, 2011, another indicator stating that the financial crisis is still affecting the economy of Montenegro.

Tourism is the most important industry branch in Montenegro. Montenegrin tourism is one of the fastest growing tourist industries in the World. Therefore, the Montenegrin economy is nowadays mostly a service-based. Its biggest goal for the next period is to become a major European elite tourist destination by attracting foreign direct investment in the tourism sector. The foreign investors were largely investing in big infrastructure projects as well as Greenfield investments. The biggest investors into Montenegrin economy are following international and regional companies: Interbrew, Daido Metal, Hit Gorica, Hellenic Petroleum, Nova Ljubljanska Banka, Magyar Telecom, Rusal and Societe Generale (VIP Broker Macroeconomic Data 2012).

Montenegro Stock Exchange (MNSE) was established by four largest banks from Montenegro in June 1993. The Exchange is today entirely privately owned company. Since February 2008, MNSE is a member of world largest family of exchanges – World Federation of Exchanges (WFE). According to the WFE Board of directors the Montenegrin market is “growing market with the big opportunities and possibilities, and if young, with achieved impressive results”. Additionally, MNSE is a member of Federation of European Stock Exchanges (FESE) since June 2007 and the Federation of Euro Asian Stock Exchanges since September 2005. MNSE fully merged with the other principal stock exchange of Montenegro - NEX Stock Exchange Podgorica in January 2011 and therefore formed a single Montenegrin capital market. The agreement on data vending with Vienna Stock Exchange was signed in November 2011.

Traders of MNSE mainly trade securities (short and long-term) and investment funds. Official MNSE index is MONEX20. MONEX20 is a price index, weighted by 20 biggest issuers on the Exchange. The participation of each issuer in MONEX20 is weighted on the basis of capitalization, turnover and the number of transactions made



on Montenegro Stock Exchange. Each company is limited to 20% of index capitalization.

#### **4.6. FYR Macedonia**

Former Yugoslavian Republic of Macedonia peacefully gained its independence in 1991. The breakup Yugoslavian war did not take place on Macedonian territory. However, Macedonia was the least developed one of all former Yugoslavian republics producing about 5% of the total goods and services of total Yugoslavian federal output. Additional problem for Macedonia is the dispute with Greece about its name. Greece's objection to the name Macedonia is due to its Hellenic heritage and that delayed Macedonian international recognition. Macedonians had to agree to use the name Former Yugoslavian Republic (FYR) of Macedonia and therefore Greece lifted the 20 months long embargo in 1995 as two countries normalized the relations. In 1996 after the dispute with Greece was over, the infrastructure problem was partially solved and the UN sanctions to Yugoslavia ended, FYR Macedonia started to experience the economic growth (Central Intelligence Agency 2011).

Macedonian economy was improved by successful privatization in 2000 and the slight increase of foreign direct investment, increased economic stability and the lowered inflation. However, Macedonian economy, predominantly service-based, is still fragile and depends on the outside sources. Macedonia is still behind the region in attracting the foreign investors and creating jobs. The unemployment rate was 31,7% for the last year. This official unemployment percentage however could be much lower in reality due to the highly developed gray market not included in official statistics measures (Central Intelligence Agency 2011).

Despite the financial crisis, due to the conservative fiscal policy and comprehensive financial system, Macedonia received the higher credit rating. Additionally, the GDP growth was positive for 2010 and the macroeconomic stability was maintained due to the monetary policy of pegging the domestic currency (Denar) to euro. However, the black economy is growing in Macedonia in recent years as well (Vaknin 2007). Vaknin (2007) anticipates that since the economy is growing the companies listed on Macedonian Stock Exchange should be interesting for the investors to buy in the future. However, due to the fact that Macedonian Stock Exchange did not perform quite well in previous years, Vaknin (2007) blames the Macedonian government activity with the

Exchange and the loss of confidence that the investors have towards the law and regulations set by the government.

Macedonian Stock Exchange (Македонска Берза) was founded in 1995, as the official trading started in March 2006. Same year Macedonian Stock Exchange was accepted as a full member of the Federation of Euro-Asian Stock Exchanges (FEAS). The Exchange officially became an affiliated member of Federation of European Stock Exchanges (FESE) in 2005. The regional integration of the Macedonian Stock Exchange was established with signing the Memorandum of Understanding with following exchanges: Ljubljana Stock Exchange (Slovenia), Athens Stock Exchange and Thessaloniki Stock Exchange (Greece), Belgrade Stock Exchange (Serbia), Zagreb Stock Exchange (Croatia), Sofia Stock Exchange (Bulgaria) and Vienna Stock Exchange (Austria). The most successful year for Macedonian Stock Exchange was 2007, when the turnover reached its maximum of 41,7 billion euros. In same year the MBI 10, the official index of the Exchange reached its peak of 10,000 index points. Additionally, in 2007 the Memorandum of Partnership was signed between the Macedonian Stock Exchange and the exchanges in Belgrade, Ljubljana and Zagreb (Macedonian Stock Exchange 2012).

MBI index is introduced in 2001 as an official index of Macedonian Stock Exchange consisting of 5 most liquid shares listed on the Exchange. However, due to the growth of the Exchange, a new index was introduced in 2005 – MBI 10. It is a price index weighted with the market capitalization and it includes up to 10 shares listed on the Exchange.

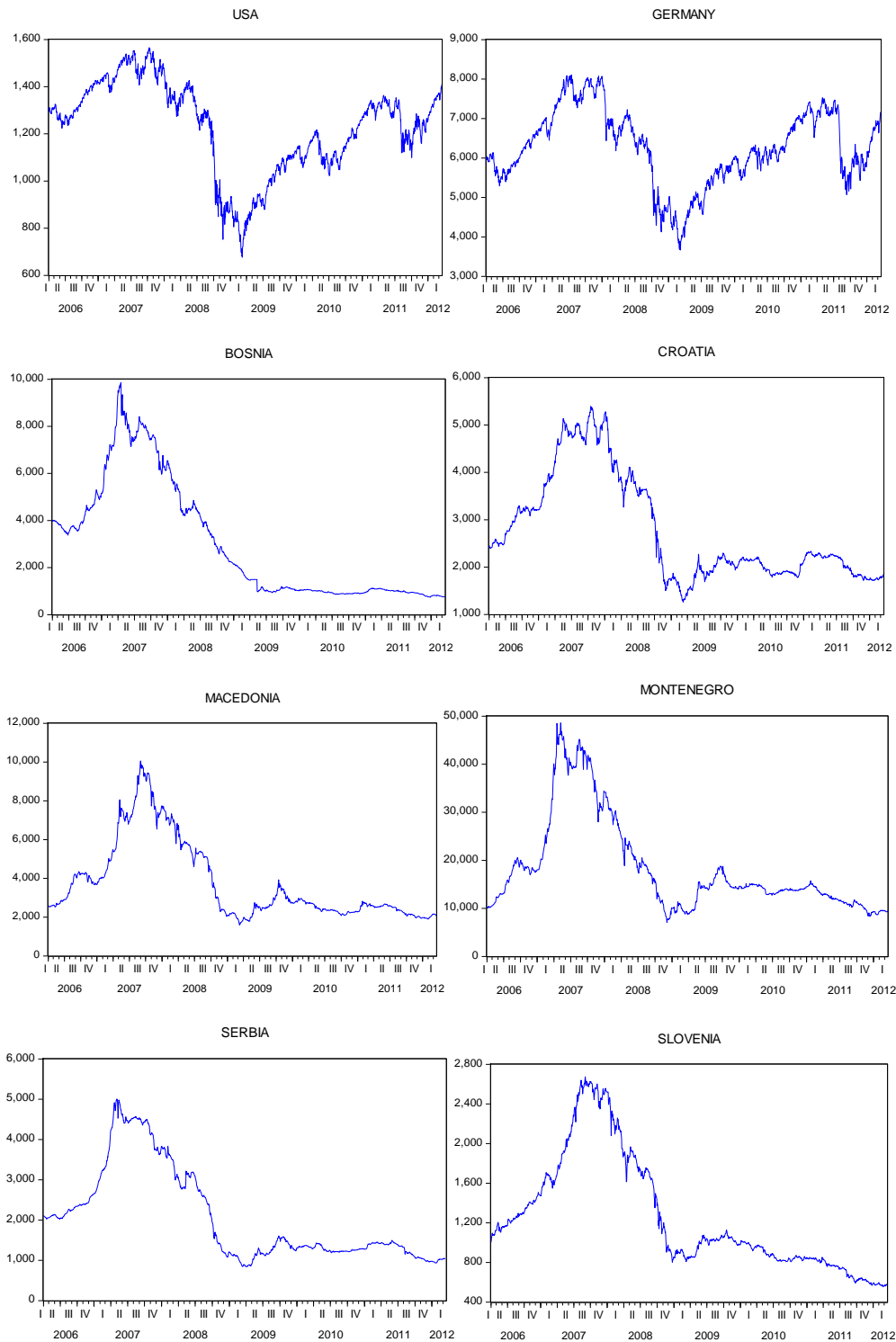
## **5. DATA AND METHODOLOGY**

This chapter introduces data used in the study. The descriptive statistics of the data is presented first as the methodology and tests used are presented in the second part of the chapter.

### **5.1. Data**

The data used in this study is extracted from Thomson Datastream database. The sample includes six former Yugoslavian countries: Serbia, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro and FYR Macedonia as well as two developed world markets U.S. and Germany. Each country used in this study is represented by its value-weighted stock exchange index: Serbia - BELEX line index (Belgrade Stock Exchange), Slovenia – SBI TOP index (Ljubljana Stock Exchange), Croatia – CROBEX index (Zagreb Stock Exchange), Bosnia and Herzegovina – SASX-10 index (Sarajevo Stock Exchange), Montenegro - MONEX 20 index (Montenegro Stock Exchange), FYR Macedonia – MBI 10 index (Macedonian Stock Exchange), United States – S&P500 index (New York Stock Exchange and NASDAQ), and Germany – DAX index (Frankfurt Stock Exchange). The daily returns are used in this study as the returns from Serbia, Croatia, Bosnia and Herzegovina and FYR Macedonia are expressed in local currencies, Germany and Slovenia in euro and United States in US dollars.

The sample period spreads from March 2006 to March 2012. Financial integration is tested for two separate periods in the sample. First period extends from March 2006 to September 2008 which represents the pre-crisis period as the crisis period is represented by September 2008 – March 2012 period. The central event of this study is September 15, 2008 which is the Lehman Brothers bankruptcy announcement date.



**Figure 5:** Stock indices from March 2006 until March 2012

New York stock Exchange (NYSE) is by far the world's largest stock exchange with about 9,57 trillion US dollars market value. The second largest stock exchange after the NYSE by market capitalization in the world is another American Exchange – NASDAQ

(National Association of Securities Dealers Automated Quotations). S&P 500 index is a free-float capitalization weighted index composed of 500 largest market capitalization companies traded in United States at NYSE and NASDAQ (New York Stock Exchange 2012).

Frankfurt Stock Exchange, operated by Deutsche Boerse, holds about 90 percent of turnover for the German market, serving as one of the biggest European stock exchanges. The major index of Frankfurt Stock Exchange is DAX which is a free float index selected from 30 German blue chip stocks that are traded at Frankfurt Stock Exchange (Frankfurt Stock Exchange 2012). Stock exchanges and indexes of former Yugoslavian countries included in this study are presented in previous chapter.

Table 7 represents descriptive statistics for daily returns of each country's equity market included into the research. Panel A reports the summary statistics for two mature markets first (US and Germany) as well as for Bosnia and Croatia. Panel B reports the descriptive statistics of remaining four countries: Macedonia, Montenegro, Serbia and Slovenia

**Table 1.** Descriptive statistics summary of daily returns from March 2006 to March 2012

Panel A: Summary statistics for USA, Germany, Bosnia and Croatia

	USA	Germany	Bosnia	Croatia
Mean	5.46E-05	0.0001	-0.0010	-0.0001
Median	0.0006	0.0004	-7.51E-05	0.0000
Maximum	0.1095	0.1079	0.0756	0.1477
Minimum	-0.0946	-0.0743	-0.4136	-0.1076
Std. Deviation	0.0153	0.0159	0.0160	0.0151
Skewness	-0.2829	0.0954	-10.9539	-0.0017
Kurtosis	11.1663	9.0477	285.5814	15.5027
Jarque-Bera	4344.401	2373.662	5208206.	10134.72
Probability	0.0000	0.0000	0.0000	0.0000
Observations	1556	1556	1556	1556

**Table 1 (continued)**

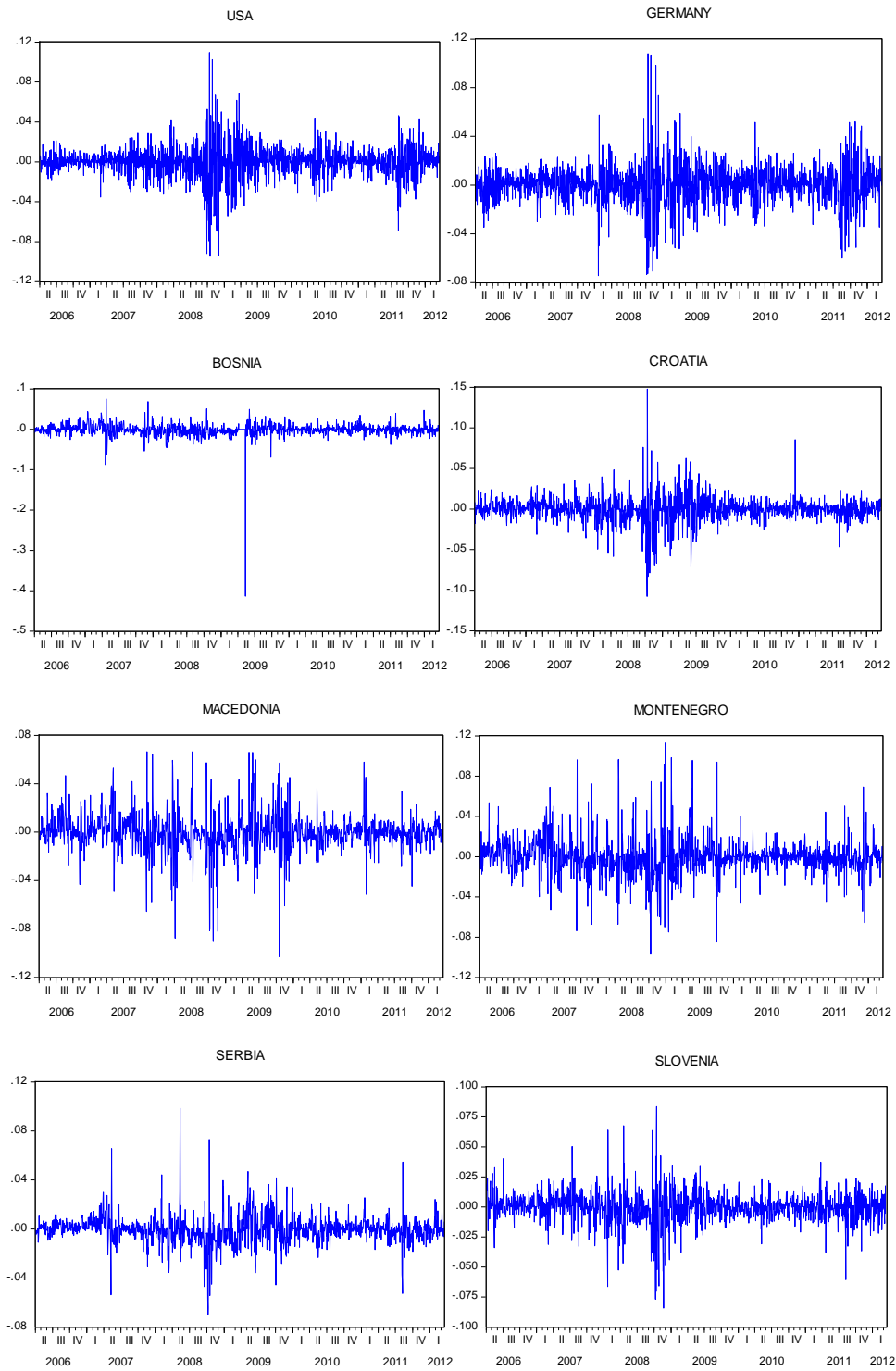
Panel B: Summary statistics for Macedonia, Montenegro, Serbia and Slovenia

	Macedonia	Montenegro	Serbia	Slovenia
Mean	-0.0001	-5.38E-05	-0.0004	-0.0003
Median	0.0000	0.0000	-5.00E-05	0.0000
Maximum	0.0666	0.1128	0.0987	0.0835
Minimum	-0.1028	-0.0970	-0.0696	-0.0843
Std. Deviation	0.0154	0.0183	0.0110	0.0127
Skewness	-0.4060	0.7260	0.3214	-0.4725
Kurtiosis	9.6287	9.8196	13.5145	10.48364
Jarque-Bera	2891.578	3151.968	7194.058	3688.907
Probability	0.0000	0.0000	0.0000	0.0000
Observations	1556	1556	1556	1556

Based on the descriptive statistics, all of the former Yugoslavian countries provided slightly negative results during the observation period for this research. The lowest returns were provided at Bosnian equity market with overall -0,11% as US and German markets provided small positive results for the sample period. Volatility for the period under research was almost identical for all of the countries included in the sample. Montenegro however had slightly higher volatility than others measured with standard deviation of 1,83%. On the other side markets with smallest volatility measured with standard deviation are Serbia (1,10%) and Slovenia (1,27%).

Returns distribution normality based on skewness and kurtiosis is rejected with Jarque-Bera statistics according to the results are reported in Table 7. Skewness is negative for the following countries: US, Bosnia, Croatia, Macedonia, and Slovenia. These results indicate that large negative stock returns are more common than the large positive ones. Germany, Montenegro, and Serbia have positive skewness indicating that large positive returns are more common than the large negative ones. Kurtiosis values reported in Table 7 exceed 3 for all of the countries in the study and indicating leptokurtic series.

All of the former Yugoslavian countries provided higher daily returns in the first period of the study (pre-crisis period) compared to developed US and German markets. However, the financial crisis struck hard all of the former Yugoslavian countries as their recovery is going very slowly compared to developed markets. The volatilities for all of the markets included in the study are represented with following Figure 4.



**Figure 4.** Returns of markets included in the study

**Table 2.** Correlation coefficient matrix of daily returns for all countries included in study

## Panel A: Pre-crisis period

	USA	GER	BOS	CRO	MCD	MNE	SRB	SLO
USA	1.0000							
Germany	0.4761	1.0000						
Bosnia	-0.0391	-0.0339	1.0000					
Croatia	0.0960	0.3498	0.0964	1.0000				
Macedonia	0.0403	0.0445	0.1240	0.1315	1.0000			
Montenegro	0.0011	0.0679	0.2439	0.1421	0.0913	1.0000		
Serbia	0.0221	0.0340	0.1493	0.1504	0.0979	0.2570	1.0000	
Slovenia	0.0383	0.1076	0.1012	0.2367	0.0999	0.0768	0.0828	1.0000

## Panel B: Crisis period

	USA	GER	BOS	CRO	MCD	MNE	SRB	SLO
USA	1.0000							
Germany	0.6895	1.0000						
Bosnia	-0.0021	0.0341	1.0000					
Croatia	0.4443	0.5497	0.0327	1.0000				
Macedonia	0.0838	0.1719	0.1061	0.2787	1.0000			
Montenegro	0.0368	0.0989	0.0996	0.1913	0.1281	1.0000		
Serbia	0.0930	0.1971	0.1945	0.2891	0.3918	0.2806	1.0000	
Slovenia	0.1518	0.3068	0.0860	0.3770	0.3676	0.2197	0.4501	1.0000

As Table 8 “Correlation coefficient matrix” suggests, the correlation of the market returns included in study increased during the crisis period. According to the Table 8 returns that are correlated the most in this study are US and Germany, which is expected as these two countries represent highly developed and mature markets, already largely integrated. During the pre-crisis period (Table 8. Panel A), US returns are not highly correlated with any of the former Yugoslavian countries. However, during the same period, German returns are showing the correlation with Croatia (0,35) and Slovenia (10,7). Among the returns of former Yugoslavian countries the most correlation in pre-crisis period existed between Serbia and Montenegro (0,25), Slovenia and Croatia (0,23), as well as Montenegro and Bosnia (0,24). Additionally, correlation in pre-crisis period exists between the following former Yugoslavian countries: Serbia-Croatia (0,15), Serbia-Bosnia (0,14), Croatia-Montenegro (0,14), Croatia-Macedonia (0,12) and Bosnia-Macedonia (0,12).

Crisis period (Table 8. Panel B) resulted in the increase in correlation between the returns of all of the countries included in the study. Again, the highest correlation exists between the returns of US and German developed markets (0,69). During the crisis period the correlation of US returns increased with Croatia (0,44) and Slovenia (0,15).



German returns are correlated with Croatia (0,55), Slovenia (0,31) and Serbia (0,15) during the crisis period. The correlation of the former Yugoslavian countries' returns drastically increased during the crisis period. Therefore, market returns that became highly correlated during the financial crisis are Serbia and Slovenia (0,45). Additionally the returns correlation of the following countries increased: Serbia and Macedonia (0,39), Croatia and Slovenia (0,37), as well as Slovenia and Macedonia (0,36). Finally The correlation increased in case of: Croatia-Macedonia (0,27), Croatia-Serbia(0,28), Serbia-Montenegro(0,28). Slovenia-Montenegro (0,21), Bosnia-Serbia (0,19), Croatia-Montenegro (0,19), and Macedonia-Montenegro (0,13).

Higher correlation of mature markets returns (US and Germany) with Slovenian and Croatian returns are expected as Slovenia is a member state of European Union since 2004 and Croatia is scheduled to become a member state of EU in 2013. One country that lacks the high correlation of returns with other markets is Bosnia. This low correlation of Bosnian returns with mature markets can be explained with their hard economic situation in post-war period (as explained in Chapter 4). Finally, former Yugoslavian countries are highly correlated with each other, which can be explained with their geographical proximity and the fact that they were part of the same country for more than 60 years before the breakup in 1991.

## 5.2. Methodology

The methodology used in this research is the error-correction vector autoregressive framework which models the financial integration. To test for the trending behavior of the returns series the joint tests for the market integration are done as the long-run linkages and interrelations are tested as well. The interrelations and linkages between the former Yugoslavian stock market with the world's developed markets are investigated by discovering the presence and number of the cointegration vectors (Syriopoulos, 2004).

To test for the presence of stochastic non-stationarity of data the following two unit root tests are taken: Augmented Dickey-Fuller test (Dickey & Fuller, 1979; 1981) and the Phillips and Perron non-parametric test (Perron 1988; Phillips & Perron 1988). This tests are taken to determine the presence of the unit root in the series of data as well as the unit root plus drift or/and a time trend. The null hypothesis of Augmented Dickey-

Fuller test (ADF) indicates that unit root  $\rho = 0$  for the  $y_t$  sequence. The rejection of the null hypothesis means the stationarity of the data series. ADF test counting the drift plus a time trend can be described with the following formula (Syriopoulos 2011):

$$(11) \quad \Delta y_t = \alpha + \mu t + \rho y_{t-1} + \sum_{i=1}^k \psi \Delta y_{t-i} + \varepsilon_t, \quad \varepsilon_t \sim i.i.d. (0, \sigma^2)$$

where:  $\Delta$  = first differences of the series

$\mu t$  = a trend variable

and  $\varepsilon_t$  = white noise term

The Phillips and Perron (1987, 1988) modified the ADF test introducing the non-parametric (PP) test. PP test is more realistic in practice because it allows for some dependence among the  $\varepsilon_t$ , as the asymptotic distribution changes. Therefore, the non-parametric correction is introduced to weaken the i.i.d. assumption from ADF test by permitting the serial correlations and heteroscedasticity (Syriopoulos, 2004). The Phillips and Perron modification test can be described as:

$$(12) \quad y_t = \alpha_0 + \alpha y_{t-1} + u_t$$

where term  $u_t$  represents the “white noise”. Therefore, the difference between two unit root tests (ADF and PP) is in their dealing with any “nuisance” within serial correlations (Syriopoulos, 2004) as the null hypothesis of PP test says that a series is non-stationary if  $\alpha = 1$ . The rejection of unit root hypothesis means that stationarity exists.

To test for the presence and number of cointegrating vectors between the selected former Yugoslavian and mature stock markets the vector error correction model (VECM) is used. The VECM is based on the Johansen procedure method developed by Johansen and Juselius (Johansen 1988, 1991, 1992, 1995; Johansen and Juselius 1990, 1992, 1994). The short and long run dynamic relationships between the series are established using the maximum Likelihood (ML) approach to multivariate autoregressive models. Johansen procedure depends on the relationships between the matrix's characteristic roots and ranks, as the common stochastic trends among the components of a vector  $z_t$  of non-stationary variables are tested (Syriopoulos 2004). The following data generating process (Syriopoulos 2004, 2011) is stated for vector  $z_t$  of  $n$  potentially endogenous variables. An unrestricted vector autoregression (VAR) model for  $k$  lags of vector  $z_t$  is following (Syriopoulos 2004, 2011):

$$(13) \quad z_t = A_1 z_{t-1} + A_2 z_{t-2} + \dots + A_k z_{t-k} + u_t \quad u_t \sim IN(0, \Sigma)$$

where  $z_t$  represents the  $(n \times 1)$  matrix as the each of  $A_i$  represent the  $(n \times n)$  parameters matrix. The vector error correction model (VECM) form of previous equation follows (Syriopoulos 2004, 2011):

$$(14) \quad \Delta z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-1} + u_t$$

where  $\Gamma_i = -(I - A_1 - \dots - A_i)$ ,  $(i = 1, \dots, k-1)$ ,  $\Pi = -(I - A_1 - \dots - A_k)$ , and  $\Gamma_i$  represent the interim multipliers. Therefore, both the short- and long-run patterns are spotted for the changes in  $z_t$  with the estimates of  $\Gamma_i$  and  $\Pi$ .  $\Gamma_i$  contain the short-run structure of financial market integration as  $\Pi$  includes the information determining the long-run relationships between the markets (Syriopoulos 2004). The matrix  $\alpha$  is used for defining the speed of the adjustments or error correction that the system is using for establishing its long-run equilibrium. The short run adjustments to the variables changes are spotted with matrix  $(\Gamma_i \dots \Gamma_{k-1})$  as the  $\beta$  is the long-run coefficient matrix. As the rank  $r < n$  for the coefficient matrix  $\Pi$  is reduced, there exists  $(n \times r)$  matrices  $\alpha$  and  $\beta$  with rank  $r$  such that  $\Pi = \alpha\beta'$  and  $\beta'z_t$  is stationary (Syriopoulos 2011). Therefore, the number of linearly independent columns –  $r$ , in matrix  $\Pi$  represents the cointegrating vectors for testing the financial integration.

As the  $z_t$  represents the vector for the non-stationary  $I(1)$  variables, the terms from equation (14) involving  $\Delta z_{t-1}$  are  $I(0)$  and therefore term  $\Pi z_{t-1}$  must be stationary as well for  $u_t \sim I(0)$  to be the “white noise” (Syriopoulos 2004). The requirement that  $\Pi z_{t-1} \sim I(0)$  can be met in three possible scenarios:

- 1)  $\Pi$  has a full rank – all of the variables of the  $z_t$  are stationary:  $z_t \sim I(0)$ . A suitable model to use in this case would be the estimation of the standard Sims-type VAR in levels
- 2) When no cointegration exists at all between the markets as there are no  $z_t \sim I(0)$ . Proper model to be used in this case is the VAR involving no long-run elements in first differences,
- 3) It exists up to  $(n-1)$  cointegration relationships as  $\beta'z_{t-k} \sim I(0)$ . In this case  $\beta$  contains  $r \geq (n-1)$  cointegration vectors as well as the  $(n-r)$  non-stationary vectors. Therefore, the cointegration is tested based on the rank of  $\Pi$  by finding the number of linearly independent columns (Syriopoulos 2004). ‘Reduced rank regression’ procedure is used for providing the estimates of  $\alpha$  and  $\beta$  (Harris, 1995).

For testing the existence of cointegrating vectors the ‘trace’ test statistics is used in this study. It represents the LR test statistic hypothesizing that there are at most  $r$  cointegrating vectors present against an alternative, stated in the following equation:

$$(15) \quad \lambda_{trace}(r) = -2 \log(Q) = -T \sum_{i=r+1}^n \log(1 - \lambda_i^2)$$

where  $i = r+1, \dots, n$ , represent the  $(n - r)$  smallest squared canonical correlations,  $r = 0, 1, 2, \dots, n - 1$ , and  $\lambda_{trace}(r) = 0$ , as all  $\lambda_i = 0$ . Osterwald-Lenum (1992) is used for acquiring the asymptotic critical values (Syriopoulos 2004).

Furthermore, Granger casualty tests are employed to determine short-run lead-lag co-dependent relationships between all of the stock markets included in the study (Alexander 2001), contrasting Johansen procedure where the long-run equilibrium is tested. Granger casualty test determines the direction of causation or how useful is one time series in forecasting the others. However, it does not imply the causation between the time series in any significant way, as the name ‘Granger casualty’ suggests (Rec 2009). Granger casualty examines whether the current value of variable  $y - y_t$  is possible to explain with same variable past value  $y_{t-k}$ . Additionally, it inspects the relationship between the lagged values of another variable  $x - x_{t-k}$  and the variable  $y_t$ . It is said that a variable is ‘Granger caused’ by  $x$  as  $x$  helps to predict  $y$  (Rec 2009; Gilmore & McManus 2002).

## 6. EMPIRICAL RESULTS

This chapter presents the results of the study. The results of Unit Root tests are presented first as a proof of the stationarity of data used in the study. Furthermore, the Johansen procedure with number and presence of cointegrating vectors results are presented. The short-run linkages between all of the countries included in the study are presented with results of Granger casualty test. Finally, the exclusion test results are revealed and the conclusions of the study are drawn.

### 6.1. Unit Root Tests

Unit root tests employed in this research are Augmented Dickey-Fuller (ADF) and Philippe Perron (PP) test. These unit roots are required as the stationarity of the data must be confirmed before the Johansen procedure and Granger casualty tests are employed. Both tests are made with and without a trend and results remained consistent. The lag length for both unit root tests was determined with Schwarz information criterion as the critical level for all of the tests was -3,434 at 1% significance level. Panel A shows the unit root test results for index daily return series used. Results of the both unit root tests confirm the stationarity of the data used in the study. Therefore, Granger casualty test can be employed.

**Table 3.** Unit Root tests - Augmented Dickey-Fuller (ADF) and Philippe Perron (PP)

Panel A. Unit roots for the daily returns

	ADF	p-value	PP	p-value
USA	-44.6914	0.0001	-45.2664	0.0001
Germany	-39.1812	0.0000	-39.2285	0.0000
Bosnia	-33.2685	0.0000	-33.3172	0.0000
Croatia	-20.2562	0.0000	-36.0132	0.0000
Macedonia	-24.4599	0.0000	-26.0823	0.0000
Montenegro	-31.1515	0.0000	-31.7292	0.0000
Serbia	-26.5014	0.0000	-27.8305	0.0000
Slovenia	-32.8441	0.0000	-32.5594	0.0000

**Table 3 (Continued).**

Panel B. Unit roots for the index values

	ADF	p-value	PP	p-value
USA	-1.37896	0.5940	-1.3379	0.6138
Germany	-1.76030	0.4006	-1.7401	0.4108
Bosnia	-0.66848	0.8524	-0.5316	0.8825
Croatia	-0.73789	0.8352	-0.8203	0.8126
Macedonia	-0.83671	0.8079	-0.9112	0.7851
Montenegro	-1.75849	0.4015	-1.0153	0.7498
Serbia	-0.40652	0.9057	-0.5247	0.8839
Slovenia	-0.23613	0.9314	-0.2546	0.9289

Panel B of the Table 9 shows the Augmented Dickey-Fuller and Philippe Perron tests for the daily index values data. Results reported indicate that the null hypothesis of a unit root cannot be rejected for any price index series at any level of significance as all of the tests statistics have values greater than the critical value of -3,434. Therefore all of the variables used for daily index values are non-stationary and therefore Johanson percedure tests can be employed.

## 6.2. Granger Casualty

This subchapter presents the Granger casualty test results for two periods: pre-crisis period (April 3, 2006 to September 12, 2008) and the financial crisis period (September 15, 2008 to March 19, 2012). As explained earlier, Lehman Brothers bankruptcy announcement on September 15, 2008 is set to be the trigger point for the financial crisis in this study. First reported is table 10 that represents the empirical results for the Granger casualty test during the pre-crisis period.

**Table 4.** Granger Casualty tests during pre-crisis period

Panel A: Granger Casualty for USA, Germany, Bosnia, Croatia, and Macedonia during pre-crisis period: April 3, 2006 – September 12, 2008

Markets	F-statistics	Probability
USA → Bosnia	1.7543	0.1547
USA → Croatia	11.595	2.E-07***
USA → Germany	26.837	2.E-16***
USA → Macedonia	1.0409	0.3738
USA → Montenegro	3.1667	0.0240*
USA → Serbia	1.5973	0.1888
USA → Slovenia	19.452	5.E-12***
Germany → Bosnia	3.5946	0.0135*
Germany → Croatia	1.3718	0.2503
Germany → Macedonia	0.1086	0.9550
Germany → Montenegro	1.0501	0.3698
Germany → Serbia	2.1076	0.0981*
Germany → Slovenia	16.609	2.E-10***
Germany → USA	1.3971	0.2426
Bosnia → Croatia	4.2588	0.0054**
Bosnia → Germany	0.5421	0.6536
Bosnia → Macedonia	2.7107	0.0443*
Bosnia → Montenegro	3.1998	0.0230*
Bosnia → Serbia	5.4981	0.0010**
Bosnia → Slovenia	0.4971	0.6844
Bosnia → USA	0.6886	0.5592
Croatia → Bosnia	3.6678	0.0122*
Croatia → Germany	1.5331	0.2047
Croatia → Macedonia	6.1630	0.0004***
Croatia → Montenegro	16.061	5.E-10***
Croatia → Serbia	6.4853	0.0003***
Croatia → Slovenia	12.687	5.E-08***
Croatia → USA	2.7774	0.0405*
Macedonia → Bosnia	1.1255	0.3380
Macedonia → Croatia	3.1026	0.0262*
Macedonia → Germany	0.5593	0.6420
Macedonia → Montenegro	5.8494	0.0006***
Macedonia → Serbia	1.9816	0.1155
Macedonia → Slovenia	1.4708	0.2213
Macedonia → USA	2.0636	0.1038

*Note:* Significance levels for p-values: \*=significant at 10% level, \*\*=significant at 5% level, and \*\*\*=significant at 1% level.

**Table 4 (Continued).** Granger Casualty tests during pre-crisis period

Panel A: Granger Casualty for Montenegro, Serbia, and Slovenia during pre-crisis period: April 3, 2006 – September 12, 2008

Markets	F-statistics	Probability
Montenegro → Bosnia	2.0058	0.1119
Montenegro → Croatia	1.6074	0.1864
Montenegro → Germany	0.2931	0.8304
Montenegro → Macedonia	5.0003	0.0020**
Montenegro → Serbia	3.6487	0.0125*
Montenegro → Slovenia	0.3590	0.7826
Montenegro → USA	0.0362	0.9908
Serbia → Bosnia	9.6736	3.E-06***
Serbia → Croatia	2.8667	0.0359*
Serbia → Germany	1.5424	0.2023
Serbia → Macedonia	4.1522	0.0063**
Serbia → Montenegro	4.4199	0.0044**
Serbia → Slovenia	0.0853	0.9681
Serbia → USA	1.0056	0.3898
Slovenia → Bosnia	1.5479	0.2009
Slovenia → Croatia	0.2117	0.8883
Slovenia → Germany	2.9237	0.0333*
Slovenia → Macedonia	0.8132	0.4868
Slovenia → Montenegro	6.8601	0.0001***
Slovenia → Serbia	1.4901	0.2160
Slovenia → USA	0.2574	0.8560

*Note:* Significance levels for p-values: \*=significant at 10% level , \*\*=significant at 5% level, and \*\*\*=significant at 1% level.

As the results from table 10 suggest US market Granger cause returns of Germany, Croatia and Slovenia significantly at 1% level. Additionally the US market Granger causes the returns of Montenegro as well but only on 10% level, which is not highly significant. Other former Yugoslavian countries are not Granger caused by US market during the pre-crisis period. Another mature market in this study, Germany highly significantly Granger causes the returns of Slovenia only. Additionally, Germany does Granger cause Bosnian and Serbian results but only at 10% level. According to these results it can be noted that Slovenian market has shown the highest levels of Granger dependence towards the both US and German markets of all former Yugoslavian countries. Concerning the test results of other former Yugoslavian countries it can be



noted that Croatia can represent a dominant market in the region Granger causing the results of Macedonia, Montenegro, Serbia and Slovenia significantly at 1% level. Serbian market significantly Granger causes the returns on Bosnian market. Furthermore, Serbian market Granger causes Macedonia and Montenegro at 5% level. Unidirectional causality is observed in case of Slovenia → Montenegro highly significantly at 1% level. Bosnian market Granger causes the returns of Serbian and Croatian markets at 5% level. Bidirectional casualty is not found at 1% level for the pre-crisis period but it exists at 5% level between Montenegro and Macedonia.

**Table 5.** Granger Casualty tests during the crisis period

Panel A: Granger Casualty for Montenegro, Serbia, and Slovenia during the crisis period: September 15, 2008 – March 19, 2012

Markets	F-statistics	Probability
USA → Bosnia	6.2810	0.0003***
USA → Croatia	20.350	9.E-13***
USA → Germany	20.782	5.E-13***
USA → Macedonia	43.090	5.E-26***
USA → Montenegro	7.0738	0.0001***
USA → Serbia	47.444	2.E-28***
USA → Slovenia	97.969	6.E-55***
Germany → Bosnia	3.3958	0.0174*
Germany → Croatia	5.3527	0.0012**
Germany → Macedonia	19.267	4.E-12***
Germany → Montenegro	3.6965	0.0116*
Germany → Serbia	18.176	2.E-11***
Germany → Slovenia	33.147	2.E-20***
Germany → USA	4.2425	0.0055**
Bosnia → Croatia	1.3016	0.2726
Bosnia → Germany	0.1905	0.9029
Bosnia → Macedonia	0.5264	0.6642
Bosnia → Montenegro	0.1065	0.9563
Bosnia → Serbia	1.1510	0.3275
Bosnia → Slovenia	2.6192	0.0497*
Bosnia → USA	1.3293	0.2635

*Note:* Significance levels for p-values: \*=significant at 10% level, \*\*=significant at 5% level, and \*\*\*=significant at 1% level

**Table 5 (Continued).** Granger Casualty tests during the crisis period

Panel B: Granger Casualty for USA, Germany, Bosnia, Croatia, and Macedonia during the crisis period: September 15, 2008 – March 19, 2012

Markets	F-statistics	Probability
Croatia → Bosnia	9.1758	6.E-06***
Croatia → Germany	4.7923	0.0026**
Croatia → Macedonia	32.497	6.E-20***
Croatia → Montenegro	15.107	1.E-09***
Croatia → Serbia	19.766	2.E-12***
Croatia → Slovenia	36.968	2.E-22***
Croatia → USA	4.4228	0.0043**
Macedonia → Bosnia	5.5426	0.0009***
Macedonia → Croatia	1.0668	0.3623
Macedonia → Germany	0.3065	0.8207
Macedonia → Montenegro	2.8845	0.0348
Macedonia → Serbia	1.7784	0.1496
Macedonia → Slovenia	3.3870	0.0177*
Macedonia → USA	0.3206	0.8105
Montenegro → Bosnia	1.6977	0.1659
Montenegro → Croatia	1.1876	0.3133
Montenegro → Germany	0.8401	0.4720
Montenegro → Macedonia	5.4906	0.0010**
Montenegro → Serbia	2.7009	0.0446*
Montenegro → Slovenia	3.0224	0.0289*
Montenegro → USA	0.3896	0.7605
Serbia → Bosnia	9.4715	4.E-06***
Serbia → Croatia	2.8042	0.0388*
Serbia → Germany	1.2564	0.2881
Serbia → Macedonia	5.0002	0.0019**
Serbia → Montenegro	13.357	2.E-08***
Serbia → Slovenia	5.6393	0.0008***
Serbia → USA	0.6988	0.5529
Slovenia → Bosnia	1.3438	0.2588
Slovenia → Croatia	2.9077	0.0338*
Slovenia → Germany	1.0983	0.3489
Slovenia → Macedonia	2.0598	0.1040
Slovenia → Montenegro	2.9356	0.0325*
Slovenia → Serbia	3.3289	0.0191*
Slovenia → USA	0.9533	0.4142

*Note:* Significance levels for p-values: \*=significant at 10% level, \*\*=significant at 5% level, and \*\*\*=significant at 1% level

Table 11 summarizes the results of Granger Casualty test for the crisis period of the study. The major difference among the results displayed is that there is much more Granger causality present among the market returns during the crisis period versus the pre-crisis period. The empirical results indicate that US market Granger causes the returns of every single former Yugoslavian country at the high significance 1% level. As mentioned earlier, only the returns of Croatia and Slovenia were Granger caused by US market during the pre-crisis period. Additionally, German market returns are Granger caused by the US market during the crisis period at 1% level as well. German market highly significantly Granger causes the returns of Macedonia, Serbia and Slovenia during the crisis period as increase from only causing the returns of Slovenia during the pre-crisis period. Additionally, German market Granger causes the returns of Croatia at 5% level as well as Bosnia and Montenegro at 10% level. Therefore, it can be concluded that the Granger casualty test shows much more casualty specifically from US market but from German market as well to all of the former Yugoslavian market returns.

Regarding the test results among the former Yugoslavian countries, Croatia remains the dominant market Granger causing all of the other countries in the region highly significantly at 1% level. Another country that Granger causes other markets highly significantly is Serbia, causing Bosnian, Montenegrin and Slovenian returns at 1% level. Additionally, Serbian market is Granger causing the returns of Macedonia at 5% level. According to the results reported in table 11, Granger causality is also found in case Macedonia  $\rightarrow$  Montenegro at 1% level. However the direction of Granger causality Montenegro  $\rightarrow$  Macedonia appears to exist only on 5% level of significance. According to the Granger casualty tests, during the crisis period Bosnia remains the market that is most segmented to the other countries in the region and the world's developed markets.

### **6.3. Johansen Procedure**

As the unit root tests showed the stationarity of data, Johanson procedure for examining the presence and number of cointegrating vectors is employed next. Johanson procedure tests were made for two periods: pre-crisis period (April 6, 2006 until September 12, 2008) and the period during the financial crisis (September 15, 2008 to March 19, 2012). According to procedure by Johansen, a vector-error correction model is estimated for eight series jointly (Syriopoulos 2004, 2011; Johansen 1991). The choice

for optimal lags is selected based on Hannan-Quinn information criterion (HQ). Three lags were chosen to both pre- and during the crisis periods. Osterwald-Lenum asymptotic critical values criteria is selected as intercept and trend in CE – no intercept in VAR cointegration test specification is chosen for both periods as well. Table 12 reports the cointegrating vectors test results for the pre-crisis period (Panel A) and the crisis period (Panel B).

**Table 6.** Trace tests for cointegration

Panel A. Pre-crisis period: April 6, 2006 - September 12, 2008

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	5 Percent Critical Value	1 Percent Critical Value
None**	0.1226	273.2397	182.82	196.08
At most 1**	0.0728	189.9160	146.76	158.49
At most 2**	0.0691	141.7856	114.90	124.75
At most 3*	0.0531	96.14981	87.31	96.58
At most 4	0.0447	61.36012	62.99	70.05
At most 5	0.0256	32.24542	42.44	48.45
At most 6	0.0197	15.69611	25.32	30.45
At most 7	0.0047	3.000309	12.25	16.26

Panel B. Crisis period: September 15, 2008 - March 19, 2012

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	5 Percent Critical Value	1 Percent Critical Value
None**	0.0972	299.2487	182.82	196.08
At most 1**	0.0676	206.0055	146.76	158.49
At most 2**	0.0421	142.1650	114.90	124.75
At most 3**	0.0337	102.8983	87.31	96.58
At most 4**	0.0331	71.58107	62.99	70.05
At most 5	0.0212	40.83214	42.44	48.45
At most 6	0.0171	21.30076	25.32	30.45
At most 7	0.0061	5.592570	12.25	16.26

Note: \*(\*\*) denotes rejection of the hypothesis at the 5% (1%) level

Table 12 reports the results from the  $\lambda_{trace}$  test statistics. Additionally the  $\lambda_{max}$  (Max-Eigen Statistic) tests are done as well, however no meaningful results were found. In case that these two tests show different results it is preferred to report the  $\lambda_{trace}$  test results (Johansen & Juselius 1990, Syriopoulos 2011). It has proven that the  $\lambda_{trace}$  test shows a more power results since it takes all of the  $n - r$  values of smallest eigenvalues into the account (Kasa, 1992; Serletis & King, 1997). Generally, the more cointegrating vectors that the test finds the higher the probability for the long run equilibrium for the equity markets included in the study (Syriopoulos 2011).

The null hypothesis for the  $\lambda_{trace}$  test, which states that the equity markets are not cointegrated ( $r = 0$ ) is rejected for both pre-crisis and the crisis period in this study. Johansen procedure trace test results for the pre-crisis period (Table 12 – Panel A) show the existence of 4 cointegrating vectors at 5% level and 3 cointegrating vectors at more significant 1% level. Panel B reports that during the financial crisis period, trace test finds the existence of 5 cointegrating vectors at both 5% and 1% levels. According to these results, markets included in this study got more integrated during the financial crisis period and the long-run equilibrium between them is present.

As the results show, cointegrating vectors are present between the markets included in the study. Therefore, the comovements and linkages are expected to exist in the future as the long-term relationship between examined markets is established. The presence of cointegrating vectors and the long run equilibrium between the markets in this study can be attributed to fairly common path of former Yugoslavian countries' economies (towards the EU membership) as well as the growing inflow of foreign direct investments.

#### **6.4. Exclusion Test**

Due to the large number of cointegrating vectors found between the markets included in the study indicating significant level of financial integration and long-run equilibrium, the Block Exogeneity Wald test is additionally employed. Block Exogeneity Wald test was taken for two periods: pre-crisis period (April 6, 2006 until September 12, 2008) and the period during the crisis (September 15, 2008 to March 19, 2012). For the dependent variables the two mature developed markets are chosen (USA and Germany). The purpose of the test is to see specifically which former Yugoslavian countries integrate with the mature US and German markets and which can be excluded from the

long-run relationships. The results of the test are summarized in following tables 7 and 8.

**Table 7.** Exclusion test: Pre-crisis period

Panel A: Dependent variable: USA

Excluded market	Chi-sq	df	Prob.
Germany	3.433083	3	0.3295
Croatia	9.432681*	3	0.0241
Serbia	1.964578	3	0.5798
Slovenia	0.476155	3	0.9241
Bosnia	3.894726	3	0.2731
Macedonia	5.325744	3	0.1494
Montenegro	0.674084	3	0.8793

Panel B: Dependent Variable: Germany

Excluded market	Chi-sq	df	Prob.
Germany	70.77842*	3	0.0000
Croatia	5.401204	3	0.1447
Serbia	3.141678	3	0.3703
Slovenia	8.583387*	3	0.0354
Bosnia	2.549833	3	0.4664
Macedonia	3.006144	3	0.3907
Montenegro	1.364038	3	0.7140

*Note:* The test for pre-crisis period is performed given three cointegrating vectors. An asterisk denotes the rejection of null hypothesis at the 5% significance level.

**Table 8.** Exclusion test: Financial crisis period

Panel A: Dependent variable: USA			
Excluded market	Chi-sq	df	Prob.
Germany	11.46935*	3	0.0094
Croatia	12.95655*	3	0.0047
Serbia	2.838870	3	0.4171
Slovenia	4.409086	3	0.2205
Bosnia	3.746668	3	0.2902
Macedonia	0.787141	3	0.8525
Montenegro	1.776731	3	0.6200

Panel B: Dependent Variable: Germany			
Excluded market	Chi-sq	df	Prob.
USA	47.40468*	3	0.0000
Croatia	15.12370*	3	0.0017
Serbia	3.370693	3	0.3379
Slovenia	2.991078	3	0.3930
Bosnia	2.701249	3	0.4400
Macedonia	1.580184	3	0.6639
Montenegro	5.576568	3	0.1341

*Note:* The test for pre-crisis period is performed given five cointegrating vectors. An asterisk denotes the rejection of null hypothesis at the 5% significance level.

As the exclusion test indicates, former Yugoslavian countries that can be excluded from the cointegration relationships with US market during the pre-crisis period are: Serbia, Slovenia, Bosnia, Montenegro and Macedonia. During the same period the stock market index prices that are excluded from the long-run relationships with German market are: Croatia, Serbia, Bosnia, Macedonia, and Montenegro. Therefore, pre-crisis exclusion test indicates that only Croatia and Slovenia from all of the former Yugoslavian countries are integrated with the mature markets of US and Germany.

Table 8 reports the exclusion test for the financial crisis period. Serbia, Slovenia, Bosnia, Macedonia, and Montenegro are ruled out from the long-run relationships from both US and German markets at 5% significance level. Therefore, Croatia remains the

only markets in the region of former Yugoslavia that maintained the long-run relationship equilibrium with both US and German markets. Its position as a dominant market in the region of former Yugoslavia remains after the exclusion test is performed. Slovenia was included in the cointegration with Germany during the pre-crisis period as well.

## 6.5. Conclusions of the study

In general, the empirical results of the study confirm a considerable level of financial integration between some of the markets included in the study. As the study investigates the financial integration for two periods, before and during the financial crisis, it can be concluded that cointegration relationships between the markets strengthened during the crisis period. Johanson procedure tests revealed that all of the countries included in this study (USA, Germany, Serbia, Slovenia, Croatia, Bosnia, Montenegro, and Macedonia) become more integrated during the crisis period as the number of cointegrating vectors increased from 3 (pre-crisis period) to 5 (period during the financial crisis). Additionally, Granger casualty tests revealed the significantly larger number of short-run interdependencies between the returns during the financial crisis period compared to the pre-crisis. Granger casualty test also reveals that US market affects the returns of every former Yugoslavian market significantly in the short-run during the financial crisis period (During the pre-crisis period, only Croatian and Slovenian returns were affected by US market returns significantly).

However, as the exclusion test is additionally performed, it can be concluded that the increase in cointegration between all of the markets included in the study is caused by two reasons. First, the mature markets of US and Germany increased the comovements between each other and Croatia. Slovenia was included in these relationships during the pre-crisis period as well. This result support the first hypothesis of this study: “*Croatia and Slovenia are integrated more with developed markets compared to other former Yugoslavian countries*”. The cointegration of Croatia and Slovenia with developed markets found in this study is consistent with results of previous studies of Nikkinen et al (2011), Syriopoulos (2011), Samitas (2006), Rec (2009) and Vizek & Dedic (2006). These result are expected as Slovenia is a member country of EU since 2004 and Croatia enjoys the status of candidate and is scheduled to become a full member in 2013.



Second, during the financial crisis period, the increase in cointegration between all of the markets included in the study (as indicated with Johansen procedure tests) was also caused by increased cointegration between the former Yugoslavian markets themselves. As the exclusion test indicates, the markets of Serbia, Bosnia, Macedonia and Montenegro (and also Slovenia during the crisis period) are ruled out from the long-run equilibrium with US and German markets. These results are also confirmed with simple correlation results as the correlation drastically increased during the crisis period for the following countries: Serbia-Slovenia, Croatia-Slovenia, Slovenia-Macedonia, Serbia-Macedonia, Croatia-Serbia, Montenegro-Serbia, Croatia-Macedonia, Slovenia-Montenegro, Bosnia-Serbia and Montenegro-Macedonia. The results of increased short-run cointegration between the markets during the crisis stay in line with Young et al. (2003). Additionally, an increased cointegration between the returns of Serbia-Bosnia and Serbia-Slovenia is consistent with the results of Rec (2009). Therefore, the second hypothesis of this study “*Financial crisis resulted in higher integration of all former Yugoslavian countries with developed markets*” gained weak support, as only Croatia remained on the long-run equilibrium path with developed markets during the financial crisis.

Croatia represents the dominant market in the region of former Yugoslavia significantly affecting every other former Yugoslavian market's returns. This result is consistent with the findings in Piljak (2008). The role of Croatian market in the region increased even more during the financial crisis period. The exclusion test additionally confirmed the role of Croatia as the dominant market in the region as Croatian market is integrated more with the developed markets than any other former Yugoslavian country. Additionally, role of Serbian market in the region increased considerably during the crisis period. Serbian market returns significantly caused the returns of Bosnia, Montenegro, Macedonia, and Slovenia during the financial crisis period.

Granger casualty test further confirms bidirectional casualty relationship between Montenegro and Macedonia, Serbia and Bosnia, as well as US and Germany. Montenegro-Macedonia interdependence and good relations can be attributed to excellent political ties between the two countries with no existing open issues (which is the case with some other former Yugoslavian countries). Additionally, both Montenegro and Macedonia share the common goal of joining the EU and NATO in near future. Bidirectional relationship between Serbia and Bosnia can be explained with strong economic and political ties between Serbia and Republic of Srpska (one of two political entities in Bosnia mostly populated with Serbs). Finally, a bidirectional relationship

between US and Germany was expected as these two countries represent only two highly developed markets among the countries included in this study.

Potential opportunity for international investors' diversification benefits is rather limited when it comes to investing in some of the former Yugoslavian markets, specifically Croatia and Slovenia. According to the results of this study the long-run equilibrium between the returns of Croatia, Slovenia, US and Germany exists indicating that potential risk diversification may be very limited for the international investors. Other former Yugoslavian markets displayed the considerable level of only short-run linkages and comovements with mature markets, especially during the financial crisis period. However, these countries are ruled out from the long-run equilibrium with the developed markets and therefore the diversification benefits can be pursued by investing in Serbia, Montenegro, Macedonia and Bosnia.

Finally, it should be mentioned that the limitation of this study is that only one risk factor is taken into consideration which is the global market risk. The country specific risks as well as the currency and exchange rate risks are not taken into consideration for the purpose of this study. Therefore, a suggestion for some further researches of former Yugoslavian markets would be to take into consideration other risks as well.

## 7. SUMMARY

Former Yugoslavian countries are typical example of European frontier markets as they are located in a middle-income economic region, relatively small in size, less liquid compared to emerging markets but still retaining their own equity exchanges. The research of frontier market integration with developed markets increased in past decade due to the profitable diversification opportunities derived from investing in segmented frontier markets. However, the financial markets of former Yugoslavian countries have not been the topic of many research papers due to the political and economic instability in that geographical region in the past.

The purpose of this study is to add to a limited body of research about the financial integration of former Yugoslavian countries. The financial crisis of late 2000s is taken into consideration as it represents the major economic event in recent history. Additionally, the causation and co-movements between all of the countries included in the study are investigated as well. Finally, additional aim of this study is to familiarize readers with the economic conditions of the region of former Yugoslavia, the local equity exchanges' characteristics as well as the possibilities for international diversification benefits.

The data set contains of the daily returns of six former Yugoslavian countries: Serbia, Slovenia, Croatia, Montenegro, Macedonia and Bosnia and Herzegovina. Additionally, two developed markets are included in the study USA and Germany. The sample period spreads from March 2006 to March 2012. Financial integration is tested for two separate periods in the sample. First period extends from March 2006 to September 2008 which represents the pre-crisis period as the financial crisis period is represented by September 2008 – March 2012 period. The central event of this study is September 15, 2008 which is the date of Lehman Brothers bankruptcy announcement. The empirical study is conducted using the vector autoregressive framework (Syriopoulos 2004; 2011). Financial integration and dynamic linkages are tested with Johansen procedure cointegration vectors as the causation short-run lead-lag co-dependent relationships between the stock markets included in the study is analyzed using Granger causality tests. Additionally the exclusion test is performed to spot the markets that can be ruled out from the long-run equilibrium.

The empirical results of the study display the following conclusions:

- Croatia and Slovenia showed the higher level of financial integration towards developed markets than other former Yugoslavian countries
- Serbia, Montenegro, Macedonia and Bosnia are still not integrated into developed markets in the long-run
- The financial integration and comovements among the former Yugoslavian countries increased during the financial crisis
- Croatia is a dominant market in the region of former Yugoslavia effecting the returns of every other market in the region significantly
- The role of Serbian market in regional integration increased considerably during the financial crisis period
- Montenegro and Macedonia as well as Serbia and Bosnia showed the significant level of interdependence in the region
- Diversification benefits and superior portfolio returns for international investors are rather limited when it comes to investing in Croatia and Slovenia. However diversification benefits can be pursued by investing in other former Yugoslavian countries (Serbia, Bosnia, Montenegro and Macedonia).

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## APPENDIX 1: Economic Indicators

Table 9: Economic Indicators – Serbia (Source: World Bank 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Financial sector:</b>											
Population, total (millions)	7,31	7,50	7,50	7,48	7,46	7,44	7,41	7,38	7,35	7,32	7,29
GDP - current (billions US\$)	6,08	11,39	15,10	19,55	23,64	25,23	29,22	38,95	47,76	40,14	38,42
GDP per capita (current US\$)	809	1,518	2,013	2,613	3,168	3,391	3,942	5,276	6,497	5,484	5,268
GDP per capita, PPP (current international \$)	5,768	6,222	6,586	6,926	7,803	8,525	9,440	10,113	11,484	11,057	11,280
GDP growth (annual %)	5,34	5,30	4,12	2,67	9,30	5,40	3,60	5,40	3,80	-3,50	0,95
Inflation, consumer prices (annual %)	71,12	95,01	19,49	9,88	11,03	16,12	11,72	6,39	12,41	8,12	6,14
Unemployment, total (% of total labor force)	*	*	*	*	18,5	20,8	20,8	18,1	13,6	16,6	
Foreign direct investment, net (BoP, current, billions US\$)	*	*	*	*	*	*	*	2,474	2,714	1,880	1,151
<b>Capital markets:</b>											
Market capitalization of listed companies (current, millions US\$)	*	*	734	1,417	3,280	5,408	10,985	23,933	12,165	11,521	9,690
Stocks traded, total value (current, millions US\$)	4,8	0,9	110	535	442	666	1,339	2,550	1,248	562	237
Financing via international capital markets (gross inflows, % of GDP)	0	0	0	0	0	0	0	2,39	0,45	0	0
Listed domestic companies, total	6	7	99	342	404	864	1,111	1,771	*	*	*
Stocks traded, turnover ratio (%)	*	*	*	49,80	18,85	15,34	16,35	14,61	6,92	4,75	2,23
Market capitalization of listed companies (% of GDP)	*	*	4,86	7,20	13,84	21,43	37,59	60,77	24,90	27,66	24,76
Stocks traded, total value (% of GDP)	0,08	0,01	0,73	2,72	1,87	2,64	4,59	6,48	2,56	1,35	0,61

\* data not available for that year



Table 10: Economic Indicators – Slovenia (Source: World Bank 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Financial sector:</b>											
Population, total (millions)	1,98	1,99	1,99	1,99	1,99	2,00	2,00	2,01	2,02	2,03	2,05
GDP - current (billions US\$)	19,97	20,49	23,13	29,15	33,83	35,71	38,94	47,30	54,60	49,05	46,90
GDP per capita (current US\$)	10045	10291	11603	14607	16944	17855	19406	23441	27015	24051	22851
GDP per capita, PPP (current international \$)	17552	18441	19769	20520	22279	23476	25440	27234	29230	27499	27063
GDP growth (annual %)	4,27	2,94	3,83	2,93	4,40	4,01	5,85	6,87	3,59	-8,01	1,38
Inflation, consumer prices (annual %)	8,88	8,42	7,47	5,58	3,59	2,48	2,46	3,61	5,65	0,86	1,84
Unemployment, total (% of total labor force)	7,2	5,7	6,3	6,7	6,3	6,5	6	4,8	4,4	5,9	
Foreign direct investment, net (BoP, current, millions US\$)	70,5	37,0	1508,3	-174,3	281,5	-88,5	-255,9	-268,6	458,8	-884,2	439,3
<b>Capital markets:</b>											
Market capitalization of listed companies (current, millions US\$)	2547	2839	4606	7134	9676	7898	15181	28963	11771	11766	9428
Stocks traded, total value (current, millions US\$)	464,9	793,7	1003,4	731,5	1169,9	788,1	1019,0	2713,3	1407,9	1020,6	272,1
Financing via international capital markets (gross inflows, % of GDP)	0	0	0	0	0	0	0	0	0	0	0
Listed domestic companies, total	38	38	35	134	140	116	100	87	84	76	71
Stocks traded, turnover ratio (%)	19,67	29,47	26,95	12,46	13,92	8,97	8,83	12,29	6,91	8,67	2,57
Market capitalization of listed companies (% of GDP)	12,81	13,93	19,97	24,55	28,69	22,09	38,98	61,21	21,54	23,94	19,74
Stocks traded, total value (% of GDP)	2,34	3,89	4,35	2,52	3,47	2,20	2,62	5,73	2,58	2,08	0,57

\* data not available for that year

Table 11: Economic Indicators – Croatia (Source: World Bank 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Financial Sector:</b>											
Population, total (millions)	4,42	4,44	4,44	4,44	4,43	4,44	4,44	4,43	4,43	4,42	4,42
GDP - current (billions US\$)	21,5	23,0	26,5	34,1	41,0	44,8	49,8	59,3	69,9	63,4	60,8
GDP per capita (current US\$)	4862	5192	5974	7690	9237	10090	11229	13376	15767	14323	13754
GDP per capita, PPP (current international \$)	10920	11662	12572	13416	14446	15346	16809	18701	20364	20037	19516
GDP growth (annual %)	3,75	3,66	4,88	5,37	4,13	4,28	4,94	5,06	2,17	-5,99	-1,19
Inflation, consumer prices (annual %)	4,63	3,76	1,67	1,77	2,03	3,34	3,21	2,87	6,07	2,38	1,05
Unemployment, total (% of total labor force)	16,1	20,5	15,1	13,9	13,7	12,6	11,1	9,6	8,3	9,1	*
Foreign direct investment, net (BoP, current, billions US\$)	1,10	1,39	0,55	1,92	0,73	1,55	3,20	4,71	4,71	1,59	0,47
<b>Capital markets:</b>											
Market capitalization of listed companies (current, billions US\$)	2,74	3,31	3,97	6,12	10,95	12,91	29,00	65,97	26,79	25,63	24,91
Stocks traded, total value (current, millions US\$)	188,2	117,4	146,5	237,4	494,1	798,2	1822,8	4087,5	3440	1418	1037
Financing via international capital markets (gross inflows, % of GDP)	0	0	0	0	0	0	0	0	0	0	0
Listed domestic companies, total	64	62	66	66	145	145	183	353	376	247	221
Stocks traded, turnover ratio (%)	7,07	3,88	4,02	4,70	5,78	6,69	8,70	8,61	7,42	5,41	4,10
Market capitalization of listed companies (% of GDP)	12,76	14,40	14,99	17,94	26,73	28,82	58,18	111,22	38,32	40,41	40,94
Stocks traded, total value (% of GDP)	0,88	0,51	0,55	0,70	1,21	1,78	3,66	6,89	4,92	2,24	1,70

\* data not available for that year

Table 12: Economic Indicators – Bosnia and Herzegovina (Source: World Bank 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Financial sector:</b>											
Population, total (millions)	3,69	3,74	3,77	3,78	3,78	3,78	3,78	3,77	3,77	3,76	3,76
GDP - current (billions US\$)	5,50	5,74	6,65	8,37	10,02	10,76	12,25	15,24	18,51	17,04	16,57
GDP per capita (current US\$)	1491	1534	1762	2213	2651	2847	3241	4033	4905	4525	4409
GDP per capita, PPP (current international \$)	4445	4677	4968	5269	5750	6240	7086	7884	8654	8541	8590
GDP growth (annual %)	5,50	4,40	5,30	4,00	6,10	5,00	6,20	6,84	5,42	-2,91	0,80
Inflation, consumer prices (annual %)	*	*	*	*	*	*	6,13	1,52	7,42	-0,39	2,19
Unemployment, total (% of total labor force)	*	*	*	*	*	*	31,8	29,7	23,9	*	*
Foreign direct investment, net (BoP, current, millions US\$)	146,1	118,4	267,7	381,7	708,3	607,3	764,1	2042,3	965,4	234,6	187,8
<b>Capital markets:</b>											
Market capitalization of listed companies (current, millions US\$)											*
Stocks traded, total value (current, millions US\$)											*
Financing via international capital markets (gross inflows, % of GDP)											*
Listed domestic companies, total											*
Stocks traded, turnover ratio (%)											*
Market capitalization of listed companies (% of GDP)											*
Stocks traded, total value (% of GDP)											*

\* data not available for that year

Table 13: Economic Indicators – Montenegro (Source: World Bank 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Financial sector:</b>											
Population, total (thousands)	632	630	628	627	626	626	627	627	629	630	631
GDP - current (billions US\$)	0,98	1,16	1,28	1,71	2,07	2,26	2,69	3,67	4,52	4,14	4,11
GDP per capita (current US\$)	1556	1840	2043	2721	3307	3601	4299	5842	7183	6569	6310
GDP per capita, PPP (current international \$)	6304	6542	6793	7125	7656	8246	10319	12252	13778	12899	13016
GDP growth (annual %)	3,1	1,1	1,9	2,5	4,4	4,2	8,6	10,7	6,9	-5,7	2,5
Inflation, consumer prices (annual %)	*	*	*	*	*	*	2,92	4,35	8,76	3,47	0,65
Unemployment, total (% of total labor force)	*	*	*	*	*	30,3	*	*	*	*	*
Foreign direct investment, net (BoP, current, billions US\$)	*	*	*	*	*	*	*	*	*	*	*
<b>Capital markets:</b>											
Market capitalization of listed companies (current, millions US\$)	*	*	*	0,35	1,05	1,75	3,70	2,86	4,29	3,60	
Stocks traded, total value (current, millions US\$)				30,3	24,7	103,9	288,1	375,4	105,2	327,6	31,0
Financing via international capital markets (gross inflows, % of GDP)	0	0	0	0	0	0	0	0	0	0	0
Listed domestic companies, total	*	*	*	10	10	19	16	*	32	28	29
Stocks traded, turnover ratio (%)	*	*	*	*	*	14,81	20,57	13,77	3,21	9,16	0,79
Market capitalization of listed companies (% of GDP)	*	*	*	*	17,15	46,46	65,04	100,82	63,34	103,57	90,02
Stocks traded, total value (% of GDP)	*	*	*	1,78	1,19	4,61	10,69	10,23	2,33	7,91	0,77

\* data not available for that year

Table 14: Economic Indicators – FYR Macedonia (Source: World Bank 2012)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Financial sector:</b>											
Population, total (millions)	2,01	2,01	2,02	2,03	2,03	2,04	2,04	2,05	2,05	2,05	2,06
GDP - current (billions US\$)	3,58	3,43	3,79	4,75	5,51	5,98	6,56	8,16	9,83	9,31	9,19
GDP per capita (current US\$)	1785	1705	1875	2345	2712	2937	3211	3984	4791	4528	4460
GDP per capita, PPP (current international \$)	5942	5835	6037	6434	7023	7880	8769	9490	10908	11142	11159
GDP growth (annual %)	4,55	-4,53	0,85	2,82	4,63	4,35	5,03	6,15	4,95	-0,92	1,80
Inflation, consumer prices (annual %)	6,61	5,20	2,31	1,10	0,93	0,16	3,27	3,61	7,22	-0,27	2,12
Unemployment, total (% of total labor force)	32,2	30,5	31,9	36,7	37,2	37,3	36	35	33,7	32,2	
Foreign direct investment, net (BoP) current, millions US\$)	215	446	105	117	321	94	423	700	600	185	293
<b>Capital markets:</b>											
Market capitalization of listed companies (current, millions US\$)	7,1	46,0	182,1	361,7	413,1	645,9	1098,4	2715,2	823,4	922,2	2647,0
Stocks traded, total value (current, millions US\$)	119,1	47,0	28,5	10,9	33,0	97,1	195,3	504,4	156,1	61,3	35,8
Financing via international capital markets (gross inflows, % of GDP)	0,00	0,00	0,00	0,00	0,00	3,04	0,00	0,18	0,00	2,63	0,00
Listed domestic companies, total	1	2	78	98	68	57	43	38	38	36	34
Stocks traded, turnover ratio (%)	1612,9	177,1	25,02	4,04	8,54	18,34	22,39	26,45	8,82	7,02	2,01
Market capitalization of listed companies (% of GDP)	0,20	1,34	4,80	7,81	7,70	11,11	17,24	33,28	8,37	9,94	29,03
Stocks traded, total value (% of GDP)	3,32	1,37	0,75	0,24	0,62	1,67	3,06	6,18	1,59	0,66	0,39

\* data not available for that year